APPENDIX G

Methodology for Urban and Agricultural Demand Projections

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URBAN DEMAND

Public Water Supply and Domestic Self-Supplied

Public water supply (PWS) and domestic self-supplied demand projections have been developed for the Lower West Coast Planning Area for the period through 2010. Water supply demands were projected by multiplying population projections by per capita water use rates. The population projections for each potable water service area were based on data from the local comprehensive plans. Per capita water use rates were determined based on 1990 population data from the U.S. Bureau of the Census and the water pumpage for each utility as reported by U.S. Geological Survey (USGS).

The regional water utility service areas used in this analysis were generalized from the service areas defined in the utilities' water use permits. It was assumed that all population growth within the service areas will be connected to a public water supply system. However, as Figure II-4 in the background document shows, there are large areas that are not within utility service areas. In order to account for these areas (which are assumed to be self-supplied), they are referred to as "Planning Areas" in the population and demand estimates and projections.

Population

1990 Estimates. U.S. Census data for 1990 was used as the basis for the 1990 population (Table G-1). Block group level information was used as the basic unit of analysis. Total population, total housing units, occupied housing units, and persons per occupied housing unit were from the 100 percent Census data (Strategic Mapping, 1992). The total units connected to a public water system and total units self-supplied were from the STF3A sample census data (U.S. Bureau of the Census, 1992). Estimates of occupied units connected to public water systems and occupied units that are self-supplied for each block group were calculated. It was assumed that the percentage of units occupied for public water system connected and self-supplied units was the same as the percentage for all units. Population served by PWS and those who are self-supplied was calculated by multiplying the occupied units by the persons per occupied unit value for the respective block group.

The geographic areas represented by the Census block groups and the utility service areas were input as polygon coverages into the SFWMD GIS (using ARC-INFO Version 6.1.1 software). Population density for those served by PWS and those self-supplied were calculated for each block group assuming a uniform density within each block group. The two coverages were joined to create a new polygon coverage with the attribute data from the two original coverages. Population estimates of PWS served and self-supplied were then recalculated for the new polygon coverage by multiplying the area of the polygon by the population density. The populations for each service area were then totaled.

The results were reviewed and then modified to overcome limitations of the assumptions used. The service areas used in this analysis are generally larger than the block groups. Assuming that population is evenly distributed throughout a block group was generally not a problem in this analysis. However, there are instances where this assumption is a problem. The spatial size of block groups is much larger in areas of less development than those areas which are more heavily developed. In certain areas where urban densities are adjacent to very low intensity development or undeveloped areas and where the block group is split by a service area boundary, it

TABLE G-1. Estimated and Projected Population in the LWC Planning Area.

City	Census Data (1990)*	Comp. Plan Data (2010)**
Collier County Area:		
Collier Unincorporated	132,273	266,807
Naples	19,505	26,000
Everglades	321	662
COLLIER CO. AREA TOTAL	152,099	293,469
Hendry County:		
Hendry Unincorporated	16,985	26,790
Clewiston	6,085	7,355
La Belle	2,703	7,465
HENDRY COUNTY TOTAL	25,773	41,610
Lee County:		
Lee Unincorporated	209,448	373,212
Fort Myers	45,206	110,962
Cape Coral	74,991	147,820
Sanibel	5468	8,522
LEE COUNTY TOTAL	335,113	640,516
REGIONAL TOTAL	512,985	975,595

Source: *U.S. Bureau of the Census, 1992. **City of Cape Coral, 1990; City of Clewiston, 1990; City of Everglades City, 1990; City of Fort Myers, 1988; City of La Belle, 1990; City of Naples, 1989; City of Sanibel, 1988; Collier County, 1989; Hendry County, 1989; and Lee County, 1989.

is possible to under-estimate the population in the developed area and to over-estimate the population in the less developed area. In such areas, adjustments to the population estimates were made. For example, the block groups in the Immokalee area are large and cover the urban area and the surrounding rural areas. The Immokalee Utility service area splits these block groups. An adjustment was made to assume that all PWS served population in these block groups were served by Immokalee Utilities. Conversely, an adjustment was also made for the self-supplied population in these block groups to assume that all self-supplied in these block groups were in the East County Area. The GIS analysis evenly distributed the population over the entire block groups, when in fact the population is concentrated in a small portion of the block groups. The results of the GIS analysis were reviewed and adjustments were made in these instances.

2010 Projections

Local comprehensive plan population data were used as the basis for population projections for 2010 (Table G-1). The geographic distribution of the 2010 population was determined using Traffic Analysis Zone (TAZ) population projections for the portion of the region covered by TAZs. The geographic distribution of the 2010 population for areas not covered by TAZs was determined from information in the individual county's comprehensive plans. Total population was controlled to the total from these local government comprehensive plans.

The geographic areas represented by the TAZs, cities and the utility service areas were input as polygon coverages into the SFWMD Geographic Information System (using ARCINFO Version 6.1.1 software). The TAZ coverage for Collier County was modified to include additional areas whose population was based on comprehensive planning area information. Population density was calculated for each TAZ assuming a uniform density within each zone. The coverages were joined to create a new polygon coverage with the attribute data from the original coverages. Population estimates were then recalculated for the new polygon coverage by multiplying the area of the polygon by the population density. The populations for each service area were then totaled and controlled to local comprehensive plan projections totals. Since Hendry County does not have TAZs, it was assumed that the 2010 population distribution was the same as those calculated in the 1990 Census analysis.

Per Capita Rates

Per capita water use rates for each utility were estimated by dividing (a) raw water pumped by (b) the population served by public water supply utilities. Raw water withdrawal data was provided by the USGS. Population and the number of individuals served by the utilities were determined by the above-mentioned methodology. Per capita rates were estimated for 1990. Self-supplied water use rates for 1990 were assumed to be the same as the utility in that service area. The per capita rates for the planning areas were assumed to be the same as the PWS per capita rates for the appropriate County Utility service area.

In estimating the per capita water rates for 1990, water used by seasonal residents was included in the pumpage data. Irrigation demand for PWS served households using private well water for their irrigation was not estimated.

Demand

Demand was defined as population times per capita water use rate. For each service area, a Public Water Supply (PWS) demand and a domestic self-supplied demand were estimated for 1990. A Public Water Supply and domestic self-supplied demand for each service area were also projected for 2010. For 2010, it was assumed that all population growth within each service area will be provided potable water by the PWS utility. Current self-supplied demand within the service areas was assumed to remain constant.

Summary

Using the above-stated methodology, the total population estimates for the LWC Planning Area for 1990 was 512,633. The projected total population for 2010 increased to 976,652. The estimated water demand for urban users was 97 million gallons per day (MGD) in 1990. Water demand was projected to increase 91 percent from 1990 to 2010 to a total water demand of 185 MGD.

Table G-2 shows the per capita water use rate for each service area, the population estimates, and the resulting water demand for 1990. Table G-3 shows the per capita water use rate for each service area, the population projections, and the resulting water demand for 2010. The demands quantify only demands for the water resource, and make no assumptions about its availability or conveyances. Charlotte, Glades, and Monroe counties were not included in the tables because they contain very little urban uses.

TABLE G-2. Population and Water Demand Estimates, 1990.

Service Area Name	Utility Supplied Population	Utility Supplied Use (MGD)	Computed GPCD*	Self-Supplied Population	Self-Supplied Use (MGD)	Service Area Population	Service Area Use (MGD)
Collier County:							
Collier County	44,959	10.22	227	8,324	1.89	53,283	12.11
Everglades City	642	0.10	156	3	0.00	645	0.10
Florida Cities (Golden Gate)	7,700	0.90	117	6,413	0.75	14,113	1.65
Immokalee	15,105	2.47	164	243	0.04	15,349	2.51
Marco Island	10,194	5.27	517	70	0.04	10,264	5.31
Naples	49,833	17.35	348	634	0.22	50,467	17.57
North Naples	525	0.17	324	3	0.00	528	0.17
Orangetree	170	0.19	1116	9	0.01	179	0.20
Collier Planning Area 1	0	0.00	0	7,272	1.65	7,272	1.65
Collier County Total	**129,128**	**36.67**	**284**	**22,971**	**4.60**	**152,099**	**41.27**
Hendry County:							
Clewiston/South Shore/U.S. Sugar	13,139	2.85	217	0	0.00	13,139	2.85
GDU - Port La Belle	1,907	0.20	105	0	0.00	1,907	0.20
La Belle	3,194	0.56	175	0	0.00	3,194	0.56
Hendry Correctional	589	0.3	509	0	0.00	589	0.30
Hendry Planning Area 1	0	0	217	6,621	1.44	6,621	1.44
Hendry County Total	**18,830**	**3.91**	**208**	**6,621**	**1.44**	**25,451**	**4.79**
Lee County:							
Bayshore	408	0.03	73	0	0.00	408	0.03
Bonita Springs	16,250	2.15	132	1,684	0.22	17,934	2.37

TABLE G-2. Population and Water Demand Estimates, 1990 (Continued).

Service Area Name	Utility Served Population	Utility Supplied Use (MGD)	Computed GPCD*	Self-Supplied Population	Self-Supplied Use (MGD)	Service Area Population	Service Area Use (MGD)
Lee County Continued:							
Cape Coral	59,169	10.11	171	17,117	2.92	76,286	13.03
Citrus Park	1,108	0.12	108	0	0.00	1,108	0.12
Florida Cities South	39,804	5.70	143	2,428	0.35	42,232	6.05
Florida Cities Waterway	6,703	0.97	145	265	0.04	6,968	1.01
Fort Myers	43,737	6.24	143	616	0.09	44,353	6.33
Gasparilla	698	0.38	541	27	0.01	724	0.39
Gulf	13,387	1.74	130	3,301	0.43	16,687	2.17
Harbor	644	0.05	78	86	0.01	730	0.06
Island Water Association	5,873	3.18	541	108	0.06	5,981	3.24
Lake Fairway	1,643	0.12	73	0	0.00	1,643	0.12
Lee County	68,541	9.11	133	9,205	1.22	77,746	10.33
Lehigh Acres	13,872	1.28	92	9,081	0.84	22,953	2.12
Orange Harbor	524	0.05	95	0	0.00	524	0.05
Pine Island	7,057	1.22	173	575	0.10	7,632	1.32
Spring Creek	387	0.04	103	0	0.00	387	0.04
USEPPA	6	0.02	3264	0	0.00	6	0.02
Lee Planning Area 1	0	0	135	332	0.04	332	0.04
Lee Planning Area 2	0	0	135	9,843	1.33	9,843	1.33
Lee Planning Area 3	0	0	135	636	0.09	636	0.09
Lee County Total	**279,811**	**42.51**	**152**	**55,302**	**7.73**	**335,113**	**50.24**
Region Total	**427,769**	**83.09**	**194**	**84,893**	**13.77**	**512,663**	**96.86**

*Gallons per capita per day.

Note: Clewiston/Southshore includes population and use for customers in Glades and Palm Beach counties.

TABLE G-3. Population and Water Demand Estimates, 2010.

Service Area Name	Utility Served Population	Utility Supplied Use (MGD)	Projected GPCD*	Self-Supplied Population	Self-Supplied Use (MGD)	Service Area Population	Service Area Use (MGD)
Collier County:							
Collier County	131,476	29.89	227	8,324	1.89	139,800	31.78
Everglades City	1,303	0.20	156	3	0.00	1,306	0.20
Florida Cities (Golden Gate)	9,790	1.14	117	6,413	0.75	16,203	1.89
Immokalee	22,059	3.61	164	243	0.04	22,303	3.65
Marco Island	28,297	14.63	517	70	0.04	28,367	14.66
Naples	59,173	20.60	348	634	0.22	59,807	20.82
North Naples	1,147	0.37	324	3	0.00	1,150	0.37
OrangeTree	774	0.86	1116	9	0.01	783	0.87
Collier Planning Area 1	0		227	23,751	5.40	23,751	5.40
Collier County Total	**254,019**	**71.31**	**281**	**39,450**	**8.35**	**293,469**	**79.66**
Hendry County:							
Clewiston/South Shore/U.S. Sugar	17,855	3.87	217	0	0.00	17,855	3.87
GDU - Port La Belle	2,996	0.31	105	0	0.00	2,996	0.31
La Belle	8,495	1.49	175	0	0.00	8,495	1.49
Hendry Correctional	926	0.47	509	0	0.00	926	0.47
Hendry Planning Area 1	0	0.00	217	10,394	2.26	10,394	2.26
Hendry County Total	**30,272**	**6.15**	**203**	**10,394**	**2.26**	**40,666**	**8.41**
Lee County:							
Bayshore	408	0.03	73	0	0.00	408	0.03
Bonita Springs	41,325	5.47	132	1,684	0.22	43,009	5.69

TABLE G-3. Population and Water Demand Estimates, 2010 (Continued).

Service Area Name	Utility Served Population	Utility Supplied Use (MGD)	Projected GPCD*	Self-Supplied Population	Self-Supplied Use (MGD)	Service Area Population	Service Area Use (MGD)
Lee County Continued:							
Cape Coral	89,664	15.32	171	17,117	2.92	106,781	18.25
Citrus Park	1,108	0.12	108	0	0.00	1,108	0.12
Florida Cities South	88,420	12.66	143	2,428	0.35	90,847	13.01
Florida Cities Waterway	10,935	1.58	145	265	0.04	11,199	1.62
Fort Myers	67,408	9.62	143	616	0.09	68,024	9.71
Gasparilla	671	0.36	541	27	0.01	698	0.38
Greater Pine Island	14,362	2.48	173	575	0.10	14,937	2.58
Gulf	27,548	3.58	130	3,301	0.43	30,849	4.01
Harbor	1,242	0.10	78	86	0.01	1,328	0.10
Island Water Association	17,965	9.73	541	108	0.06	18,073	9.79
Lake Fairway	1,643	0.12	73	0	0.00	1,643	0.12
Lee County	154,392	20.52	133	9,205	1.22	163,596	21.74
Lehigh Acres	51,296	4.73	92	9,081	0.84	60,377	5.57
Orange Harbor	524	0.05	95	0	0.00	524	0.05
Spring Creek	387	0.04	103	0	0.00	387	0.04
USEPPA	6	0.02	3,264	0	0.00	6	0.02
Lee Planning Area 1	0	0.00	135	2,013	0.27	2,013	0.27
Lee Planning Area 2	0	0.00	135	19,053	2.58	19,053	2.58
Lee Planning Area 3	0	0.00	135	5,656	0.77	5,656	0.77
Lee County Total	**569,303**	**86.53**	**152**	**71,213**	**9.84**	**640,516**	**96.38**
Region Total	**853,594**	**163.99**	**192**	**121,057**	**20.88**	**974,651**	**184.45**

*Gallons per capita per day.

Note: Clewiston/Southshore includes population and use for customers in Glades and Palm Beach counties.

COMMERCIAL AND INDUSTRIAL

A prototype method for estimating the impact of the commercial and industrial sector on the gross per capita demand for a county is being tested by the District in conjunction with the USGS. This method involves estimating the number of employees by Standard Industrial Classification (SIC) code that can be attributed to those industries holding District water use permits, subtracting those employees from the total of each employee designation published in the current issue of "County Business Patterns" (U.S. Bureau of the Census, 1988), and then estimating the use by SIC code using the gallons per day per employee figures found in the IWR-MAIN report (Davis *et al.*, 1988). This total demand by employees was applied to the total pumpage in the county for the appropriate year, to derive a percentage of commercial and industrial use, and then to reduce the county's gross per capita by the commercial and industrial use estimate.

The employment by sector was also evaluated regarding the predominant types of employment found in the county, and if these employment types could be expected to grow at the same rate and in the same direction as the population. In the Lower West Coast Planning Area, the majority of the employees are found in the service and retail sales sectors, indicating that water demand by these sectors will generally grow along with the population. Water used for commercial and industrial purposes supplied by utilities are included with other water supply demands. Self-supplied commercial and industrial demands are shown in Table G-4. Appraised industrial self-supplied water demand was based on District permitted allocations for 1985 and 1990. Industrial self-supplied water use was assumed to increase at the same rate as the county population, with 1990 used as the base year.

TABLE G-4. Commercial and Industrial Self-Supplied Demand in Collier and Lee Counties.

County	1985	1990	1995	2000	2005	2010
Collier						
Population		152,099	186,749	221,798	257,634	293,469
Demand (MGD)	7.12	8.28	10.18	12.07	14.03	15.98
Lee						
Population		335,113	414,906	494,699	568,095	640,516
Demand (MGD)	18.7	31.3	38.8	46.2	53.0	59.8

Source: District permit files; U.S. Bureau of the Census,1992; Collier and Lee county comprehensive plans (1989).

There are no significant commercial and industrial self-supplied demands in Hendry County, and none are forecast through 2010.

RECREATION SELF-SUPPLIED

Landscape

Demand projections for this section include irrigated acreage permitted for landscape and recreation, excluding golf courses. Landscaping and recreational water use was assumed to increase at the same rate as the county population, with 1990 used as the base year. Projections for landscaping and recreation self-supplied demand are outlined in Table G-5.

TABLE G-5. Landscape Self-Supplied Demand in Collier and Lee Counties.

County	1985	1990	1995	2000	2005	2010
Collier						
Population		152,099	186,749	221,798	257,634	293,469
Demand (MGD)	2.83	4.02	4.94	5.86	6.81	7.76
Lee						
Population		335,113	414,906	494,699	568,095	640,516
Demand (MGD)	12.7	23.5	29.1	34.7	39.8	44.9

Source: District permit files; U.S. Bureau of the Census, 1992; Collier and Lee county comprehensive plans, 1989.

There are no significant landscape and recreational self-supplied demands in Hendry County, and none are forecast through the projection period.

Golf Course

Golf course irrigation requirement estimates were made by time horizon and month. Historical irrigated golf course acreage data were gathered from *The Official Florida Golf Guide* (Florida Dept. of Commerce, 1990), *Golf Guide to the South* (Florida Golfweek, 1989), *The Golf Course* (Cornish and Whitten, 1988), District water use permits, and personal communication with several of the golf courses listed. Irrigated acreage was projected using trend analysis techniques. Golf course irrigation requirements were calculated using the District's modified Blaney-Criddle permitting model.

Collier County

The golf courses presently in Collier County are described in Table G-6. The method chosen to project Collier County irrigated golf course acreage used a linear projection model of the form shown in Equation (G-1).

$$CUMIRR_t = f(Time, Popt, Dt) \qquad \text{(G-1)}$$

where:
$CUMIRR_t$ = *cumulative irrigated golf course acreage in Collier County in year t.*
Time = a time trend variable which takes the value of 1 in 1953 and increases by one unit each year.
Pop_t = *reported, projected or interpolated population (in thousands) in Collier County for year t.*
D_t = *a dichotomous variable equal to 1 in years 1976 to 1981 inclusive and 0 otherwise.*

TABLE G-6. Golf Courses in Collier County.

Name	Year Opened	Total Acres	Irrigated Acres
Naples Beach Hotel & GC	1953	110	107
Hole-In-The-Wall GC	1957	323	120
CC of Naples	1960	119	115
Royal Palm CC	1960	160	160
Palm River CC	1961	147	75
Moorings CC, The	1963	40	38
Golden Gate CC	1965	163	77
Island CC (Marco Island)	1965	160	85
Hibiscus GC	1968	174	110
Royal Poinciana GC	1969	440	312
Glades CC	1972	100	80
High Point CC	1972	20	20
Riviera GC of Naples	1972	97	85
Quail Run CC	1972	55	55
Imperial GC	1973	310	260
Wilderness CC	1974	220	120
Marco Shores CC	1975	160	80
Lakewood CC	1979	330	53
Wyndemere CC	1980	450	232
Bears Paw CC	1980	245	130
Club at Pelican Bay	1981	227	217
Naples Shores CC	1982	360	160
Eagle Creek CC	1982	125	125
Quail Creek CC	1982	680	680
Hideaway Beach GC (Habitat)	1984	20	19
Windstar G & CC (Whispering Pines)	1984	150	100
Foxfire CC	1985	320	125
Lely Resorts Flamingo	1985	165	165
Bentley Village GC	1987	46	25
Naples Golf Center	1987	45	12
Vineyards of Naples	1987	240	240
Quail Village GC	1987	65	65
Royal Wood G & CC	1988	233	96
Audubon CC	1988	150	115
Countryside	1988	100	65
Golf Club of Marco	1990	178	119
TOTAL		6,926	4,642

Historic and projected population figures were not available for all years. Where actual population figures were not available, a linear interpolation between the two adjacent available population figures was made. This may tend to make population estimates used here more highly correlated with time than they actually are. When Equation (G-1) was estimated using ordinary least squares regression, Equation (G-2) was obtained.

$$CUMIRR_t = -119.99 + \underset{(56.77)}{32.33Popt} - \underset{(-5.27)}{428.85D} \qquad \text{(G-2)}$$

Goodness of Fit Statistics
$R^2 = 0.9899$
$F = 1612.19$
$Pr F > 0 > .999$
$D - W = 2.011$
t - statistics in parentheses

"Goodness of fit statistics" are used throughout Appendix G to evaluate the accuracy of equations in describing time series of historical acreage data. A detailed explanation of goodness of fit statistics can be found in "Ecometric Models, Techniques, and Applications" (Intriligator, 1978).

Equation (G-3) was used to develop the primary projection of irrigated golf course acreage in Collier County. Population projections used to project other urban demands earlier in this appendix were used in projection models. The Collier County primary projection for irrigated golf course acreage is presented in Table G-7.

The irrigation requirements in Table G-8 were calculated by applying the projected irrigated acreage to the supplemental water requirements (as calculated by the Blaney-Criddle permitting model). Input variables used were irrigated acreage of grass from Table G-7, sandy soil with 0.4 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, with Naples as the rainfall station (Table G-9).

TABLE G-7. Historical and Projected Irrigated Golf Course Acreage in Collier County.

Year	Historical	Primary Projection	Primary -15%	Primary +15%
1960	502			
1965	777			
1970	1,199			
1971	1,199			
1972	1,439			
1973	1,699			
1974	1,819			
1975	1,899			
1976	1,899			
1977	1,899			
1978	1,899			
1979	1,952			
1980	2,314			
1981	2,531			
1982	3,496			
1983	3,496			
1984	3,615			
1985	3,905			
1986	3,905			
1987	4,247			
1988	4,523			
1989	4,523			
1990	4,642			
Projections				
1991		4,867	4,137	5,597
1992		5,093	4,329	5,867
1993		5,318	4,520	6,116
1994		5,543	4,712	6,374
1995		5,769	4,904	6,634
1996		5,994	5,095	6,893
1997		6,219	5,286	7,152
1998		6,445	5,478	7,412
1999		6,670	5,670	7,670
2000		6,895	5,861	7,929
2001		7,127	6,058	8,196
2002		7,359	6,255	8,463
2003		7,591	6,452	8,730
2004		7,822	6,649	8,995
2005		8,054	6,846	9,262
2006		8,286	7,043	9,529
2007		8,517	7,239	9,795
2008		8,749	7,437	10,061
2009		8,981	7,634	10,328
2010		9,213	7,831	10,595

TABLE G-8. Irrigation Requirements in Millions of Gallons for the Primary Irrigated Golf Course Acreage Projection in Collier County.

Average	1985	1990	1995	2000	2005	2010
January	174	207	257	307	359	410
February	202	240	299	357	417	477
March	406	482	599	717	837	957
April	590	701	871	1,041	1,216	1,391
May	673	800	994	1,188	1,388	1,588
June	506	602	748	894	1,044	1,194
July	568	676	840	1,004	1,172	1,341
August	543	645	802	959	1,120	1,281
September	349	415	516	617	720	824
October	430	511	635	759	887	1,014
November	370	440	547	654	764	874
December	242	287	357	427	499	570
TOTAL	5,033	6,007	7,466	8,823	10,422	11,922

2-in-10	1985	1990	1995	2000	2005	2010
January	188	224	278	332	388	444
February	219	261	324	387	452	517
March	424	504	627	749	875	1,001
April	609	724	900	1,076	1,257	1,438
May	711	845	1,051	1,256	1,467	1,678
June	584	694	863	1,031	1,204	1,378
July	648	770	957	1,143	1,336	1,528
August	619	736	915	1,093	1,277	1,461
September	430	511	635	759	887	1,014
October	468	556	691	826	965	1,104
November	382	454	564	674	787	901
December	252	299	372	444	519	594
TOTAL	5,534	6,579	8,0176	9,771	11,414	13,056

TABLE G-9. Supplemental Water Requirements for Grass in Collier County.

Month	Average (in.)	2-in-10 (in.)
January	1.23	1.33
February	1.43	1.55
March	2.87	3.00
April	4.17	4.31
May	4.76	5.03
June	3.58	4.13
July	4.02	4.58
August	3.84	4.38
September	2.47	3.04
October	3.04	3.31
November	2.62	2.70
December	1.71	1.78
Total	**35.74**	**39.14**

Naples rainfall station.
Soil = 0.4 inches.

Lee County

The golf courses presently in Lee County are described in Table G-10. Lee County has experienced rapid growth in irrigated golf course acreage since the early 1960s. There was an over five-fold increase in Lee County irrigated golf course acreage between 1960 and 1970. Between 1970 and 1981 Lee County golf course acreage nearly tripled, and again doubled during the 1980s. As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

Several alternative functional forms were used to forecast future Lee County golf course acreage. Because of the rapid increase in recent years, results obtained from simple trend analyses were deemed unreliable. Instead, the statistical technique of double exponential smoothing was used. (See Sullivan and Claycombe, 1977, Chapter 5 for a discussion of exponential smoothing.) In general, the procedure for calculating exponentially smoothed projections is summarized in equations (G-3) and (G-4).

$$S_t = ax_t + a(1-a)x_{t-1} + a(1-a)^2 x_{t-2} + \ldots (1-a)^t S_0^{(1)} \quad \text{(G-3)}$$

$$S_t^{(2)} = aS_t^{(1)} + (1-a)S_{t-1}^{(2)} \quad \text{(G-4)}$$

where:
$S_t^{(1)}$ = *the singly exponentially smoothed statistic for period t.*
a = *the smoothing constant.*
$S_t^{(2)}$ = *the doubly exponentially smoothed statistic.*

In order to use double exponential smoothing, initial values of $S_0^{(1)}$ and $S_0^{(2)}$ must be assumed, as well as the value of "a", the smoothing constant. As exponential smoothing is applied to the data, the initial estimates of $S_0^{(1)}$ is discounted and

TABLE G-10. Golf Courses in Lee County.

Name	Year Opened	Total Acres	Irrigated Acres
Fort Myers CC	1918	135	55
Lehigh Acres North (Lehigh CC)	1960	110	95
Cypress Lake CC	1960	150	100
Cape Coral G & RC	1963	187	187
Lehigh Acres South (Mirror Lakes)	1967	175	160
Cape Coral Executive GC	1968	29	29
El Rio GC	1968	41	35
South Seas Plantation GC	1969	300	75
Palmetto Pine CC	1970	120	95
Mirror Lakes CC	1970	175	160
Seven Lakes CC	1971	264	125
San Carlos G & CC	1972	123	101
Lochmoor CC	1972	143	81
Myerlee CC	1972	15	15
Bay Beach GC	1973	45	29
Estero Woods Village (Fountain Lakes)	1975	7	6
Six Lakes CC	1975	43	43
Landings, The	1975	50	50
Bonita Springs G & CC	1977	257	160
Lake Lawn CC	1978	33	33
Eastwood GC	1978	232	100
Beachview GC	1978	80	70
Spanish Wells CC	1979	631	90
Forest CC, The	1980	650	520
Burnt Store Marina (2 courses)	1981	419	243
Alden Pines GC	1981	72	55
Lake Fairways CC	1981	200	200
Cypress Pines CC	1982	155	89
Riverbend GC (East & West)	1982	212	23
Dunes CC	1983	340	109
Fiddlesticks CC	1983	710	265
Deltura CC	1983	300	79
Spring Creek	1983	94	75
Hideaway CC	1984	137	61
Eagle Ridge G & TC	1984	402	68
Tara Woods	1985	212	4
Cross Creek CC	1985	279	60
Pine Lakes CC	1985	366	80
Deer Run GC	1985	335	77
Terraverde CC	1985	60	12
Wildcat Run	1985	35	35
Whiskey Creek CC	1985	52	52
Bonita Bay Club	1985	151	121
Gasparilla Inn GC	1985	67	30
Vines CC, The	1985	280	72
Golfview CC	1986	40	27
Coral Oaks GC (Cape Coral Municipal)	1986	187	113
River's Edge Y & CC	1986	547	205
Pelican's Nest GC	1986	370	104
Royal Tee CC	1986	458	95
Burnt Store Marina addition	1987	209	122
Kelly Greens G & CC	1987	299	102
Sabal Springs G & RC	1987	371	50
Heritage, The	1987	214	25
Golf Villas/Bonita Springs	1988	2	2
Gateway GC	1988	190	135
Country Creek CC	1988	35	35
Coral Oaks GC	1988	122	103
Old Hickory Club	1989	313	85
Hunters Ridge	1989	270	83
TOTAL		12,616	5,486

becomes a negligible part of $S_t^{(1)}$. The same is true of $S_0^{(2)}$. The choice of an appropriate value of "a" is not so easily dismissed. A large value of "a" places more importance on the most recent data, while a small value of "a" places more nearly equal weights on observations regardless of how recent the data are. Usually "a" is selected between 0.1 and 0.3 (Sullivan and Claycombe, 1977). A search procedure was used, and it was determined that an "a" value of 0.12 was appropriate. Double exponential smoothing results in a forecasting equation of the form in Equation (G-5).

$$Y_{t+T} = a_t + b_t T \qquad \textbf{(G-5)}$$

where:
Y_{t+T} = *the forecast value of variable Y,T periods in the future, where t represents the present time period.*
$a_t = 2S_t^{(1)} - S_t^{(2)}$.
$b_t = (a/(1-a)) * (S_t^{(1)} - S_t^{(2)})$.

Note that to be consistent with notation used elsewhere, golf course acreage in year subscript t in Equation (G-5) is set equal to 0, so that Equation (G-2) is re-written as Equation (G-6).

$$Y_T = a + b * T \qquad \textbf{(G-6)}$$

When double exponential smoothing was applied to the Lee County golf acreage data, using a value of 0.12, Equation (G-7) resulted.

$$Y_T = -1101.58 + 200.71 * T \qquad \textbf{(G-7)}$$

Equation (G-8), adjusted for the amount by which it under projected irrigated acreage in 1992, and was used to develop the primary projection of irrigated golf course acreage in Lee County. This projection is presented in Table G-11.

The irrigation requirements in Table G-12 were calculated by applying projected irrigated acreages to the supplemental water requirements (as calculated by the Blaney-Criddle permitting model). Input variables used were irrigated acreage of grass from Table G-11, sandy soil with 0.8 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, with Fort Myers as the rainfall station (Table G-13).

TABLE G-11. Historical and Projected Irrigated Golf Course Acreage in Lee County.

Year	Historical	Primary Projection	Primary -15 %	Primary +15 %
1960	250			
1965	437			
1970	831			
1971	956			
1972	1,153			
1973	1,182			
1974	1,182			
1975	1,281			
1976	1,281			
1977	1,441			
1978	1,644			
1979	1,754			
1980	2,254			
1981	2,752			
1982	2,284			
1983	3,392			
1984	3,521			
1985	4,064			
1986	4,608			
1987	4,907			
1988	5,182			
1989	5,350			
1990	5,486			
1991	5,486			
1992	5,486			
Projections				
1993		5,677	4,825	6,529
1994		5,877	4,995	6,759
1995		6,078	5,166	6,990
1996		6,279	5,337	7,221
1997		6,479	5,507	7,451
1998		6,680	5,678	7,682
1999		6,881	5,849	7,913
2000		7,082	6,020	8,144
2001		7,282	6,190	8,374
2002		7,483	6,361	8,605
2003		7,684	6,531	8,837
2004		7,884	6,701	9,067
2005		8,085	6,872	9,298
2006		8,286	7,043	9,529
2007		8,888	7,555	10,221
2008		8,687	7,384	9,990
2009		8,888	7,555	10,221
2010		9,089	7,726	10,452

TABLE G-12. Irrigation Requirements in Millions of Gallons for the Primary Irrigated Golf Course Acreage Projection in Lee County.

Average	1985	1990	1995	2000	2005	2010
January	146	199	222	258	294	331
February	170	230	257	299	342	384
March	374	507	565	658	751	843
April	558	757	845	983	1,122	1,260
May	661	896	1,000	1,164	1,328	1,492
June	403	546	610	710	810	910
July	494	669	747	870	992	1,115
August	491	665	743	865	986	1,108
September	346	469	523	609	695	781
October	426	578	645	751	857	963
November	341	463	517	601	686	771
December	211	286	319	372	424	476
TOTAL	4,621	6,265	6,994	8,140	9,286	10,432

2-in-10	1985	1990	1995	2000	2005	2010
January	164	222	248	289	330	370
February	190	258	288	336	383	430
March	396	536	599	697	795	893
April	586	795	887	1,032	1,178	1,323
May	706	957	1,069	1,244	1,419	1,594
June	500	677	756	880	1,004	1,128
July	587	797	889	1,035	1,181	1,326
August	577	783	874	1,017	1,160	1,303
September	429	582	650	756	863	969
October	466	632	705	821	936	1,052
November	356	483	539	627	715	804
December	226	306	341	397	453	509
TOTAL	5,183	7,028	7,845	9,131	10,416	11,702

TABLE G-13. Supplemental Water Requirements for Grass in Lee County.

Month	Average (inches)	2-in-10 (inches)
January	1.00	1.12
February	1.16	1.30
March	2.55	2.70
April	3.81	4.00
May	4.51	4.82
June	2.75	3.41
July	3.37	4.01
August	3.35	3.94
September	2.36	2.93
October	2.91	3.18
November	2.33	2.43
December	1.44	1.54
TOTAL	31.54	35.38

Ft. Myers rainfall station.
Soil = 0.8 inches.

Hendry County Area

In 1990, there were two golf courses in the Hendry County, and both were in the LWC Plannning Area. These are described in Table G-14. No meaningful trend or explanatory model can be developed due to the small number of golf courses in the county. Therefore, projections must rely upon empirical knowledge of the golf industry in this area. The National Golf Foundation in Jupiter, which tracks the stage of development and location of all golf courses nationally, has no record of any golf course development presently occurring in Hendry County. Therefore, irrigated golf course acreage was projected to remain constant through the year 2010.

TABLE G-14. Golf Courses in Hendry County.

Name	Year Opened	Total Acres	Irrigated Acres
Clewiston GC	1959	146	62
Oxbow GC at Port La Belle	1974	240	190
TOTAL		386	252

The irrigation requirements in Table G-15 were calculated by applying the current irrigated acreage to the Blaney-Criddle permitting model. Input variables used were 252 acres of grass, sandy soil with 0.8 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, with data from the La Belle rainfall station.

TABLE G-15. Supplemental Water Requirements and Projected Irrigation Requirements for Golf Courses in Hendry County.

Month	Supplemental Water Requirements		Irrigation Requirements	
	Average (in.)	2-in-10 (in.)	Average (mg.)	2-in-10 (mg.)
January	1.08	1.18	10	11
February	1.09	1.24	10	11
March	2.30	2.49	21	23
April	3.50	3.72	32	34
May	4.35	4.67	40	43
June	2.70	3.35	25	31
July	3.42	4.03	31	37
August	3.46	4.02	32	37
September	2.48	3.02	22	28
October	2.82	3.09	26	28
November	2.31	2.40	21	22
December	1.42	1.51	13	14
TOTAL	30.93	34.72	283	317

La Belle rainfall station.
Soil = 0.8 inches.

Glades County Area

Hendry Isles Resort is the only golf course in Glades County, and it is in the LWC Planning Area. This golf course opened in 1978 and covers 72 acres, of which 20 acres are irrigated. No additional golf course development is anticipated through 2010 in Glades County. The existing acreage has average and 2-in-10 irrigation requirements of 24 MGY and 26 MGY respectively.

AGRICULTURAL WATER DEMAND

Acreage Projections

Agricultural demand was projected for all of Lee and Collier counties and the portions of Hendry, Glades and Charlotte counties within the LWC Planning Area (referred to as county areas). There is a portion of Monroe County in the planning area, but it contains no agricultural land. Agricultural irrigation and cattle watering demand estimates were made by month and time horizon (1985, 1990, 1995, 2000, 2005, and 2010). Land availability for the future growth of agriculture was examined. Crop acreage projections relied on various techniques, which are described in this text; irrigation requirements were based on these crop acreage projections and the District's modified Blaney-Criddle permitting model.

The techniques chosen to project crop acreages were those judged to best reflect the specific crop and county scenario. This led to some variation in projection techniques between crop types, and in method between counties. While it would have been ideal if a comprehensive functional form could have been found which produced tangible projections universally, no such functional form was found. The acreage projections developed reflect a combination of methods, each deemed appropriate where used.

Water demand projections were based on the extrapolation of current trends and circumstances, and consequently could not incorporate unforeseeable changes in the variables which determine water use. Projections should therefore be understood as surprise-free, and imply an extension of current production, market, and legal circumstances.

Mathematical models were used to test for the presence of crop acreage trends within individual counties. In some cases, a single mathematical model could be chosen since it accurately explained past trends, and projected a likely future scenario. In other cases, several models accurately explained past trends; and none explicitly provided more likely projections than the others. In these cases, the projections of several statistically valid and empirically sound models were averaged. This approach was justified by research performed at the Bureau of Economic and Business Research (Mahmoud, 1984), which showed that taking the average of a number of different projections reduces the chances of making large errors and leads to more reliable projections.

When no statistically valid trend, or any convincing empirical knowledge on future changes in a crop's acreage could be found, the crop's acreage was projected at its current size ($\pm$15 percent) for future time horizons. Usually these situations arose from relatively insignificant water users (in terms of quantity).

Irrigation Demands

A crop's supplemental water requirement is the amount of water used for evapotranspiration minus effective rainfall, while irrigation requirement includes both the supplemental water requirement and the losses incurred in getting irrigation to the crop's root zone. This relationship is expressed in Equation (G-8). Irrigation efficiency refers to the average percent of total water pumped or delivered for use that is stored in the plant's root zone. The overall irrigation efficiency is also equal to the product of the reservoir storage, water conveyance, and irrigation application efficiencies (Smajstrla *et al.*, 1991).

$$\textit{Irrigation requirement} = \frac{\textit{Supplemental water requirement}}{\textit{Irrigation efficiency}} \qquad \text{G-8}$$

Two values of effective rainfall are considered in calculating the supplemental crop requirements presented in this appendix. The first is a derivative of average rainfall, while the second reflects rainfall in an annual drought which has a probability of occurring two years in every ten ("2-in-10").

Projections of irrigation system type, and the effect of the corresponding estimated irrigation efficiencies, were based on the interpretation of current ratios and trends. The three basic types of irrigation systems currently used in crop production and their corresponding irrigation efficiencies (shown in parentheses) are: seepage (50 percent), overhead sprinkler (75 percent), and micro irrigation (85 percent) systems.

The usable water capacity of a soil directly affects the fraction of total rainfall that is effective. For each crop, assumptions for soil type were made for current acreage and future growth. Soil type, with regard to water use permitting by the District, refers to the soil's usable water holding capacity. The District has classified five types of soil with regard to usable soil water capacity in inches (0.2, 0.4, 0.8, 1.5, and 3.6). The locations of these soil types in the Lower West Coast Planning Area are shown by county in Figure G-1.

Unless otherwise specified, a crop's entire acreage was treated as if all took place on the most common soil type permitted for that crop in the respective county. Likewise, unless otherwise stated, the rainfall station most frequently used to permit allocations for that crop in the respective county was used.

Crop Types

The irrigated commercially grown crops in the counties of the LWC Planning Area are citrus, sugarcane, tropical fruit, vegetables, field crops, sod, and ornamental nursery plants. Pasture is rarely irrigated. However, there are some demands for cattle watering.

Agricultural irrigation and cattle watering demand estimates were made by crop type, time horizon and month. Historical crop acreage data were gathered from the Florida Department of Agriculture and Consumer Services' Florida Agricultural Statistic Service (FASS) and Division of Plant Industry (DPI); Institute of Food and Agricultural Sciences (IFAS); the U.S. Department of Agriculture's Soil Conservation Service (SCS); Southwest Florida Water Management District (SWFWMD); and District records.

Citrus

All categories of citrus (oranges, grapefruit, tangerines, etc.) were grouped together for projection purposes. Historical citrus acreage data were gathered from volumes of the "Commercial Citrus Inventory," which is published biennially by FASS.

The citrus planting rates in the Gulf Coast from 1986 to the present are at historically high levels concurrent with a period of post-freeze shifting of citrus

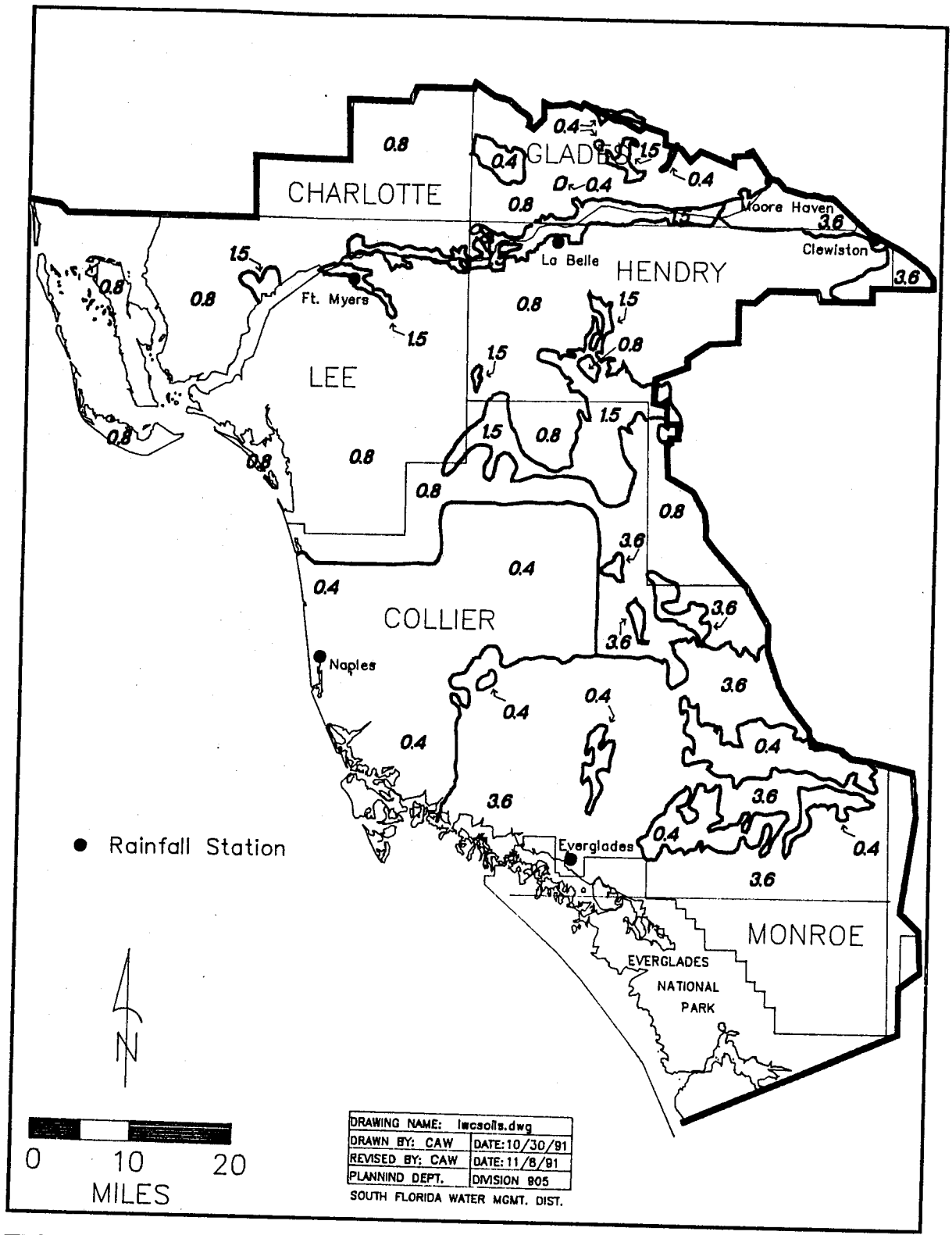

FIGURE G-1. Soil Types (in inches) in the Lower West Coast Planning Area.

acreage from central to Southwest Florida, and until recently, of relatively high market prices. This high rate of growth over a relatively short period adds apprehension to the development of acreage projections, as it is unlikely that this rate of growth will be sustainable throughout the projection period, and it is unclear when the growth rate will return to a more normal level.

In addressing future growth in the Gulf Coast citrus producing region (which includes Collier, Lee, Hendry, Glades, and Charlotte counties), Behr *et al.* (1988) developed three scenarios for future citrus planting rates (high, medium, and low). The medium planting rate is anticipated to reflect rates more consistent with the normal returns to producing citrus. This medium growth rate represents additional growth at half the rate experienced between 1986 and 1988. However, the FASS reports for 1990 indicate that the high rate of growth experienced between 1986 and 1988 (or the high scenario) has continued. Nevertheless, it is expected that there will come a point where growth will slow, but it is not clear when this is likely to occur.

Tables projecting citrus acreages for Collier, Lee, and Hendry counties outline an extrapolation of the medium planting rate scenario for future years to 1990 as outlined by Behr *et al.* (1988). Forecasting equations are presented for Glades and Charlotte counties, where recent growth has not been as extreme. Hendry is the only county in the LWC Planning Area with significant citrus nursery acreage; these irrigation requirements are projected separately.

In order to assess the types of irrigation systems in use, acreage ratios of existing systems permitted by the District were used. In recent years, micro irrigation has been the system of choice on new citrus groves for a variety of reasons. Reasons include the cost advantage that micro irrigation 'systems have over overhead sprinkler systems, and the production advantage (less time to tree maturity) micro irrigation systems have over seepage systems. However, there is still a substantial citrus acreage in the LWC Planning Area with seepage irrigation, and to a lesser extent, overhead sprinkler irrigation. The ratio of the permitted acreage in 1990 for each of the three different types of irrigation systems for citrus in each county was assessed from District permits. This ratio was applied to the acreage for 1990, and the corresponding efficiencies used to calculate irrigation requirements. All citrus planted after 1985 was assumed to have some form of micro irrigation system.

Collier County

Citrus Acreage. Table G-16 shows historical citrus acreage in Collier County and presents an extrapolation of the medium planting rate scenario for years future to 1990, as outlined by Behr *et al.* (1988). Citrus growth was capped at 52,950 acres during the land projection exercise described later in the text.

Citrus Irrigation Requirements. In 1990 permitted citrus acreage in Collier County had permitted irrigation systems in the ratio shown in Table G-17. The average and 2-in-10 supplemental water requirements for citrus at the Clewiston rainfall station, which is the most common rainfall station used to permit citrus in Collier County on 0.8 inch soil, are shown in Table G-18.

The supplemental water requirements shown in Table G-18 were divided by irrigation efficiency to yield the irrigation requirements. For example, average irrigation requirement for citrus in July 1990 is as calculated below.

TABLE G-16. Historical and Projected Citrus Acreage in Collier County.

Year	Historical	Primary projection	Primary -15 %	Primary+15 %
1966	2,605			
1968	3,933			
1970	5,052			
1972	5,228			
1974	5,474			
1976	5,396			
1978	5,975			
1980	6,706			
1982	7,931			
1984	8,425			
1986	10,063			
1988	17,309			
1990	23,565			
Projections				
1991		25,377	21,570	29,183
1992		27,188	23,110	31,266
1993		29,000	24,650	33,349
1994		30,811	26,189	35,433
1995		32,623	27,729	37,516
1996		34,434	29,269	39,599
1997		36,246	30,809	41,682
1998		38,057	32,348	43,766
1999		39,869	33,888	45,849
2000		41,680	35,428	47,932
2001		43,492	36,968	50,015
2002		45,303	38,508	52,098
2003		47,115	40,047	54,182
2004		48,926	41,587	56,265
2005		50,738	43,127	58,348
2006		52,549	44,667	60,431
2007		52,950	45,008	60,893
2008		52,950	45,008	60,893
2009		52,950	45,008	60,893
2010		52,950	45,008	60,893

Source: Historical acreage from Commercial Citrus Inventory 1966-1990, Florida Agricultural Statistics Service.

TABLE G-17. 1990 Ratio of Permitted Irrigation System Type on Citrus in Collier County.

Type of System	% of Permitted Citrus	Estimated Irrigation Efficiency
Micro-irrigation	72 percent	0.85
Overhead Sprinkler	4 percent	0.75
Seepage	24 percent	0.50

Source: SFWMD Water Supply Planning Permit Database.

TABLE G-18. Supplemental Water Requirements for Citrus at the Clewiston Rainfall Station.

Month	Average (in.)	2-in-10 (in.)
January	1.69	1.80
February	1.61	1.76
March	2.52	2.68
April	2.82	3.05
May	2.93	3.31
June	2.40	2.93
July	2.79	3.31
August	2.54	3.07
September	1.45	2.04
October	2.37	2.66
November	2.54	2.62
December	1.64	1.77
TOTAL	27.30	31.00

Soil type = 0.8 inch.

Assumptions:

- Citrus acreage for Collier County in 1990 = 23,565 acres.
- 72 percent under micro-irrigation = 16,967 acres @ 85 percent efficiency.
- 4 percent under sprinkler irrigation = 943 acres @ 75 percent efficiency.
- 24 percent under seepage irrigation = 5,656 acres @ 50 percent efficiency.

Calculation:

The average irrigation requirement for citrus in July of 1990 is:

(((2.79 in./0.85) * 16,967 acres) + ((2.79 in./0.75) * 943 acres)) +
((2.79 in./0.50) * 5,656 acres)) / 12 inches)= 7,563 ac.ft.
(7,563 ac.ft. * 325,872 gal/ac.ft.)/1,000,000 = 2,465 MG.

Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-19.

TABLE G-19. Irrigation Requirements in Millions of Gallons for the Primary Citrus Acreage Projection in Collier County.

Average	1985	1990	1995	2000	2005	2010
January	720	1,493	1,982	2,471	2,960	3,097
February	686	1,422	1,888	2,354	2,820	2,934
March	1,073	2,226	2,955	3,685	4,414	4,592
April	1,201	2,491	3,307	4,123	4,939	5,139
May	1,248	2,588	3,436	4,284	5,132	5,339
June	1,022	2,120	2,815	3,509	4,204	4,373
July	1,188	2,465	3,272	4,079	4,887	5,084
August	1,082	2,244	2,979	3,714	4,449	4,628
September	617	1,281	1,700	2,120	2,540	2,642
October	1,009	2,094	2,779	3,465	4,151	4,319
November	1,082	2,244	2,979	3,714	4,449	4,628
December	698	1,449	1,923	2,398	2,872	2,988
TOTAL	11,625	24,116	32,016	39,916	47,816	49,745
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	767	1,590	2,111	2,632	3,153	3,280
February	749	1,555	2,064	2,573	3,083	3,207
March	1,141	2,367	3,143	3,918	4,694	4,883
April	1,299	2,694	3,577	4,459	5,342	5,558
May	1,410	2,924	3,882	4,840	5,797	6,031
June	1,248	2,588	3,436	4,284	5,132	5,339
July	1,410	2,924	3,882	4,840	5,797	6,031
August	1,307	2,712	3,600	4,489	5,377	5,594
September	869	1,802	2,392	2,983	3,573	3,717
October	1,133	2,350	3,120	3,889	4,659	4,847
November	1,116	2,314	3,073	3,831	4,589	4,774
December	754	1,564	2,076	2,588	3,100	3,225
TOTAL	13,201	27,384	36,355	45,325	54,296	56,487

Lee County

Citrus Acreage. Table G-20 shows historical citrus acreage in Lee County and presents an extrapolation of the medium planting rate scenario for years future to 1990 as outlined by Behr *et al.* (1988).

TABLE G-20. Historical and Projected Citrus Acreage in Lee County.

Year	Historical	Primary Projection	Primary-15 %	Primary+15 %
1966	195			
1968	743			
1970	5,427			
1972	7,290			
1974	7,397			
1976	6,243			
1978	5,384			
1980	5,139			
1982	4,787			
1984	6,575			
1986	7,313			
1988	8,247			
1990	9,692			
Projections				
1991		9,926	8,437	11,414
1992		10,159	8,635	11,683
1993		10,393	8,834	11,951
1994		10,626	9,032	12,220
1995		10,860	9,231	12,488
1996		11,093	9,429	12,757
1997		11,327	9,628	13,025
1998		11,560	9,826	13,294
1999		11,794	10,024	13,563
2000		12,027	10,223	13,831
2001		12,261	10,421	14,100
2002		12,494	10,620	14,368
2003		12,728	10,818	14,637
2004		12,961	11,017	14,905
2005		13,195	11,215	15,174
2006		13,428	11,414	15,442
2007		13,662	11,612	15,711
2008		13,895	11,811	15,979
2009		14,129	12,009	16,248
2010		14,362	12,208	16,516

Source: Historical acreage from Commercial Citrus Inventory 1966-1990, Florida Agricultural Statistics Service.

Citrus Irrigation Requirements. In August 1990, citrus acreage in Lee County had permitted irrigation systems in the ratio shown in Table G-21. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Fort Myers on 0.8 inch soil are shown in Table G-22.

TABLE G-21. Ratio of Permitted Irrigation System Type on Citrus in Lee County.

Type of System	Percent of Permitted Citrus	Estimated Irrigation Efficiency
Micro-irrigation	50 percent	0.85
Overhead Sprinkler	0 percent	0.75
Seepage	50 percent	0.50

Source: District Water Supply Planning Permit Database.

TABLE G-22. Supplemental Water Requirements for Citrus in Lee County.

Month	Average (in.)	2-in-10 (in.)
January	1.51	1.63
February	1.48	1.62
March	2.31	2.47
April	2.98	3.15
May	3.26	3.55
June	1.47	2.07
July	2.00	2.58
August	2.05	2.60
September	1.38	1.91
October	2.30	2.57
November	2.33	2.43
December	1.78	1.88
TOTAL	24.85	28.46

Rainfall station = Fort Myers.
Soil type = 0.8 inch.

The supplemental water requirements shown in Table G-35 were divided by irrigation efficiency to yield irrigation requirements. Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-23.

TABLE G-23. Irrigation Requirements in Millions of Gallons for the Primary Citrus Acreage Projection in Lee County.

Average	1985	1990	1995	2000	2005	2010
January	499	631	688	744	800	856
February	489	619	674	729	784	839
March	763	966	1,052	1,138	1,224	1,310
April	984	1,246	1,357	1,468	1,579	1,690
May	1,077	1,363	1,484	1,606	1,728	1,849
June	485	614	669	724	779	834
July	660	836	911	985	1,060	1,134
August	677	857	933	1,010	1,086	1,163
September	456	577	628	680	731	783
October	760	961	1,047	1,133	1,219	1,305
November	769	974	1,061	1,148	1,235	1,322
December	588	744	810	877	943	1,010
TOTAL	8,206	10,388	11,315	12,242	13,169	14,095

2-in-10	1985	1990	1995	2000	2005	*2010*
January	538	681	742	803	864	925
February	535	677	738	798	858	919
March	816	1,033	1,125	1,217	1,309	1,401
April	1,040	1,317	1,434	1,552	1,669	1,787
May	1,172	1,484	1,616	1,749	1,881	2,014
June	684	865	943	1,020	1,097	1,174
July	852	1,078	1,175	1,271	1,367	1,463
August	859	1,087	1,184	1,281	1,378	1,475
September	631	798	870	941	1,012	1,083
October	849	1,074	1,170	1,266	1,362	1,458
November	802	1,016	1,106	1,197	1,288	1,378
December	621	786	856	926	996	1,066
TOTAL	9,398	11,897	12,959	14,020	15,082	16,143

Hendry County Area

Citrus Acreage. Table G-24 shows the historical citrus acreage in Hendry County and presents an extrapolation of the medium planting scenario for years future to 1990 as outlined by Behr *et al.* (1988).

TABLE G-24. Historical and Projected Citrus Acreage in Hendry County.

Year	Historical	Primary Projection	Primary-15 %	Primary+15 %
1966	16,152			
1968	19,988			
1970	22,447			
1972	22,684			
1974	24,225			
1976	25,944			
1978	28,903			
1980	30,086			
1982	32,944			
1984	36,807			
1986	40,269			
1988	54,957			
1990	73,754			
Projections				
1991		77,426	65,812	89,040
1992		81,098	68,933	93,263
1993		84,770	72,055	97,485
1994		88,442	75,176	101,708
1995		92,114	78,297	105,931
1996		95,786	81,418	110,154
1997		99,458	84,539	114,377
1998		103,130	87,661	118,599
1999		106,802	90,782	122,822
2000		110,474	93,903	127,045
2001		114,146	97,024	131,268
2002		117,818	100,145	135,491
2003		121,490	103,267	139,714
2004		125,162	106,388	143,936
2005		128,834	109,509	148,159
2006		132,506	112,630	152,382
2007		136,178	115,751	156,605
2008		139,850	118,873	160,828
2009		143,522	121,994	165,050
2010		147,194	125,115	169,273

Source: Historical acreage from Commercial Citrus Inventory 1966-1990, Florida Agricultural Statistics Service.

Citrus Irrigation Requirements. In October 1990 citrus acreage in Hendry County had permitted irrigation systems in the ratio shown in Table G-25. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in La Belle on 0.8 inch soil are shown in Table G-26. These water requirements were divided by irrigation efficiency to yield the irrigation requirements in Table G-27. In 1990, 75 percent of the citrus irrigation permitted by the District in Hendry County was in the LWC Planning Area. This is projected to change to 73 percent by 2010. Land use projections are described in detail later in the text.

TABLE G-25. Ratio of Permitted Irrigation System Type on Citrus in Hendry County.

Type of System	Percent of Permitted Citrus	Estimated Irrigation Efficiency
Micro irrigation	60 percent	0.85
Sprinkler	4 percent	0.75
Seepage	36 percent	0.50

Source: District Water Supply Planning Permit Database.

TABLE G-26. Supplemental Water Requirements for Citrus in Hendry County.

Month	Average (in.)	2-in-10 (in.)
January	1.58	1.69
February	1.41	1.56
March	2.07	2.26
April	2.68	2.89
May	3.12	3.41
June	1.43	2.03
July	2.05	2.61
August	2.16	2.68
September	1.50	2.00
October	2.23	2.49
November	2.31	2.40
December	1.75	1.84
TOTAL	24.29	27.86

Rainfall station = La Belle.
Soil type = 0.8 inch.

TABLE G-27. Irrigation Requirements in Millions of Gallons for the Primary Citrus Acreage Projection in the Hendry County Area.

Average	1985	1990	1995	2000	2005	2010
January	2,178	3,511	4,178	4,836	5,484	6,123
February	1,943	3,133	3,728	4,315	4,894	5,464
March	2,853	4,600	5,473	6,335	7,185	8,022
April	3,694	5,955	7,086	8,202	9,302	10,386
May	4,300	6,933	8,250	9,549	10,829	12,092
June	1,971	3,177	3,781	4,377	4,963	5,542
July	2,825	4,555	5,421	6,274	7,115	7,945
August	2,977	4,800	5,711	6,611	7,497	8,371
September	2,067	3,333	3,966	4,591	5,206	5,813
October	3,073	4,955	5,897	6,825	7,740	8,642
November	3,184	5,133	6,108	7,070	8,018	8,952
December	2,412	3,889	4,627	5,356	6,074	6,782
TOTAL	33,476	53,972	64,227	74,339	84,309	94,137

2-in-10	1985	1990	1995	2000	2005	2010
January	2,329	3,755	4,469	5,172	5,866	6,550
February	2,150	3,466	4,125	4,774	5,415	6,046
March	3,115	5,022	5,976	6,917	7,844	8,759
April	3,983	6,422	7,642	8,845	10,031	11,200
May	4,700	7,577	9,017	10,436	11,836	13,216
June	2,798	4,511	5,368	6,213	7,046	7,867
July	3,597	5,799	6,901	7,988	9,059	10,115
August	3,694	5,955	7,086	8,202	9,302	10,386
September	2,756	4,444	5,288	6,121	6,942	7,751
October	3,432	5,533	6,584	7,621	8,643	9,650
November	3,308	5,333	6,346	7,345	8,330	9,301
December	2,536	4,088	4,865	5,631	6,387	7,131
TOTAL	38,396	61,905	73,667	85,265	96,701	107,972

Irrigated Acreage	1985	1990	1995	2000	2005	2010
County	38,538	73,754	92,114	110,474	128,834	147,194
County Area	28,904	55,316	68,625	81,751	94,693	107,452
% in LWC	75%	75%	74.5%	74%	73.5%	73%

Citrus Nursery Acreage. Hendry is the only county in the LWC Planning Area with a significant citrus nursery acreage. Robust regression analysis was used to project citrus nursery acreage in Hendry County, as a function of Hendry County citrus acreage, a trend variable, and a dichotomous variable to reflect the abnormally high levels of citrus nursery acreage in the early years of the period under study. The model estimated took the general form of Equation (G-9). This equation is based on the awareness that the output from citrus nurseries is used as an input into citrus production.

$$HECNA_t = f(HED_t, HETOT_t, Year) \qquad \textbf{(G-9)}$$

where:
$HECNA_t$ = *citrus nursery acreage in Hendry County in year t.*
HED_t = *0 for the years 1972 and 1973 and 1 thereafter.*
$HETOT_t$ = *total citrus acreage in Hendry County in year t; (note that since citrus acreage is only measured every two years, the citrus acreage variable has the same value for two years in a row).*
Year = the year for which the estimate is being made.

The functional form represented in Equation (G-9) was estimated using robust regression analysis, resulting in Equation (G-10).

$$HECNA_t = -5445.611 - \underset{(-2.98)}{22.8029} * HED_t + \underset{(6.91)}{.003245} * HETOT_t + \underset{(2.50)}{.2.73054} * Year \qquad \textbf{(G-10)}$$

Goodness of fit statistics
$R^2 = .9703$
$F = 141.46$
$Pr\,F > 0 > .9999$
$D\text{-}W = 1.624$
t - statistics in parentheses

Equation (G-10), adjusted for the amount by which the model over-projected citrus nursery acreage in 1990 (27 acres), was used to develop the acreage projections shown in Table G-28.

TABLE G-28. Historical and Projected Citrus Nursery Acreage in Hendry County.

Year	Historical	Primary Projection	Primary-15 %	Primary+15 %
1972	13			
1973	15			
1974	15			
1975	7			
1976	14			
1977	14			
1978	Unavailable			
1979	26			
1980	33			
1981	31			
1982	28			
1983	48			
1984	53			
1985	74			
1986	91			
1987	151			
1988	147			
1989	167			
1990	178	205		
Projections				
1991		193	164	222
1992		207	176	238
1993		222	189	255
1994		237	201	273
1995		251	213	289
1996		266	226	306
1997		281	239	323
1998		295	251	339
1999		310	264	357
2000		324	275	373
2001		339	288	390
2002		354	301	407
2003		368	313	423
2004		383	326	440
2005		398	338	458
2006		412	350	474
2007		427	363	491
2008		442	376	508
2009		456	388	524
2010		471	400	542

Source: Historical acreage from Bureau of Plant Inspection Annual Report, Division of Plant Industry 1972-1990, Florida Dept. of Agr. and Consumer Services.

Citrus Nursery Irrigation Requirements. Supplemental water requirements for citrus nurseries are considered to be the same as that for citrus by the District, and are outlined for Hendry County in Table G-26. These water requirements were applied to the citrus nursery acreage projections (shown in Table G-28) to calculate the irrigation requirements (shown in Table G-29). The same distribution that was used for citrus was applied to the citrus nursery acreage.

TABLE G-29. Irrigation Requirements in Millions of Gallons for the Primary Citrus Nursery Acreage Projection in the Hendry County Area.

Average	1985	1990	1995	2000	2005	2010
January	5	11	10	13	16	18
February	4	10	9	11	14	16
March	6	15	13	17	21	24
April	8	19	17	22	27	31
May	9	23	20	25	31	36
June	4	10	9	12	14	17
July	6	15	13	17	20	24
August	7	16	14	18	21	25
September	5	11	10	12	15	18
October	7	16	14	18	22	26
November	7	17	15	19	23	27
December	5	13	11	14	17	20
Total	73	176	154	198	241	283
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	5	12	11	14	17	20
February	5	11	10	13	15	18
March	7	16	14	18	22	26
April	9	21	18	24	29	34
May	10	25	22	28	34	40
June	6	15	13	17	20	24
July	8	19	17	21	26	30
August	8	19	17	22	27	31
September	6	15	13	16	20	23
October	8	18	16	20	25	29
November	7	17	15	20	24	28
December	6	13	12	15	18	21
Total	84	202	177	227	277	325

The majority of citrus nurseries in Hendry County use overhead sprinkler systems for irrigation. Normally, overhead sprinkler irrigation systems are estimated by the District to have an irrigation system efficiency of 75 percent. However, an indeterminable number of nurseries containerize their plants, and this reduces the efficiency to approximately 20 percent. To account for this range of irrigation efficiencies, an efficiency of 50 percent was assumed for time horizons prior to 1993. After January 1993, all container nurseries will be allocated based on an 85 percent efficiency. Because citrus nurseries include both types of nursery, an average efficiency of 80 percent was used for time horizons after 1993.

Glades County Area

Citrus Acreage. Forecasting models were developed to project citrus acreage in Glades County. A variety of variables and functional forms were tested, and models of the general form of Equation (G-11) were found to best explain past trends in citrus acreage in Glades County.

$$GLCIT_t = f(time, D, RP_p, RP_w, RP_o) \quad \text{(G-11)}$$

where:
$GLCIT_t$ = *citrus acreage in Glades County in year t.*
Time = a time trend variable which takes the value of 1 in 1966 and increases by one unit each year.
RP_p, RP_w, *and* RP_o = *the real prices of Interior Region pink and white grapefruit and oranges respectively.*
D = a dichotomous variable equal to 0 before 1980 and 1 in the period 1980 and after.

The dichotomous variable corresponds closely to the onset of the series of severe winters, so the D variable picks up a portion of the interregional shift in citrus production within Florida associated with these recent severe winters. Statistical models were run which weighted all observations equally and with the weight assigned to a particular observation declining geometrically with time, with the lowest weight being assigned to the earliest observation. Weighted Glades County citrus acreage is denoted as $WGLCIT_t$. Eight specific sub-models were estimated as shown in equations (G-12) through (G-19).

$$GLCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \text{(G-12)}$$

$$WGLCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \text{(G-13)}$$

$$GLCIT_t = f(time, D) \quad \text{(G-14)}$$

$$WGLCIT_t = f(time, D) \quad \text{(G-15)}$$

$$GLCIT_t = f(time, RP_p, RP_o, RP_w) \quad \text{(G-16)}$$

$$WGLCIT_t = f(time, RP_p, RP_w, RP_o) \quad \text{(G-17)}$$

$$GLCIT_t = f(time) \quad \text{(G-18)}$$

$$WGLCIT_f = f(time) \quad \text{(G-19)}$$

Functional forms (G-12) through (G-19) were estimated using ordinary least squares regression. The results are shown in equations (G-20) through (G-27).

$$GLCIT_t = -1547.241 + \underset{(5.06)}{237.488} * time + \underset{(3.00)}{1757.5} * D + \underset{(1.71)}{520.552} * RP_w$$
$$\underset{(-1.51)}{-284.2936} * RP_o + \underset{(0.15)}{51.859} * RP_p \qquad \text{(G-20)}$$

Goodness of fit statistics
$R^2 = .9655$
$F = 39.14$
$Pr\,F > 0 > .999$
t - statistics in parentheses

$$WGLCIT_t = -3246.637 + \underset{(4.53)}{254.9774} * time + \underset{(2.79)}{1962.661} * D - \underset{(-1.17)}{263.3348} * RP_o$$
$$+ \underset{(0.98)}{357.813} * RP_w + \underset{(0.66)}{267.3135} * RP_p \qquad \text{(G-21)}$$

Goodness of fit statistics
$R^2 = .9605$
$F = 34.03$
$Pr\,F > 0 > .999$
t - statistics in parentheses

$$GLCIT_t = 661.7312 + \underset{(3.85)}{153.5731} * time + \underset{(3.40)}{2203.411} * D \qquad \text{(G-22)}$$

Goodness of fit statistics
$R^2 = .9299$
$F = 66.34$
$Pr\,F > 0 > .999$
t - statistics in parentheses

$$WGLCIT_t = -735.7443 + \underset{(4.09)}{179.6155} * time + \underset{(3.31)}{2351.752} * D \qquad \text{(G-23)}$$

Goodness of fit statistics
$R^2 = .9325$
$F = 69.11$
$Pr\,F > 0 > .999$
t - statistics in parentheses

$$GLCIT_t = -3051.487 + \underset{(8.08)}{345.2226} * time - \underset{(-0.04)}{275.7016} * RP_o + \underset{(1.68)}{705.7448} * RP_w$$
$$\underset{(-0.04)}{-16.84349} * RP_p \qquad \text{(G-24)}$$

Goodness of fit statistics
$R^2 = .9211$
$F = 23.36$
$Pr\, F > 0 > .999$
t - statistics in parentheses

$$WGLCIT_t = -4926.481 + \underset{(7.62)}{375.2878 * time} - \underset{(-0.83)}{253.7398 * RP_o} + \underset{(1.16)}{564.6245 * RP_w} + \underset{(0.35)}{190.5909 * RP_p} \quad \text{(G-25)}$$

Goodness of fit statistics
$R^2 = .9164$
$F = 21.93$
$Pr\, F > 0 > .999$
t - statistics in parentheses

$$GLCIT_t = -76.7747 + \underset{(7.86)}{262.533 * time} \quad \text{(G-26)}$$

Goodness of fit statistics
$R^2 = .8487$
$F = 61.70$
$Pr\, F > 0 > .999$
t - statistics in parentheses

$$WGLCIT_t = -1523.97 + \underset{(8.18)}{295.911 * time} \quad \text{(G-27)}$$

Goodness of fit statistics
$R^2 = .8588$
$F = 66.92$
$Pr\, F > 0 > .999$
t - statistics in parentheses

When equations (G-20) through (G-27) were used for projection purposes, the results shown as columns (G-20) through (G-27) in Table G-30 were obtained.

On the basis of recent historic growth in citrus acreage, it was observed that all models underestimated 1990 acreage. To overcome this deficiency, the projection by Equation (G-25) was selected, and future projections were adjusted by the amount by which 1990 acreage is underestimated (650 acres). This is equivalent to inserting a dichotomous intercept-shift variable into the model for the period 1990 and after. When this adjustment is made the primary projection shown in Table G-31 was obtained.

TABLE G-30. Alternative Projections for Citrus Acreage in Glades County.

Year	Historical	Column (E-20)	Column (E-21)	Column (E-22)	Column (E-23)	Column (E-24)	Column (E-25)	Column (E-26)	Column (E-27)
1966	1,413								
1968	1,461								
1970	1,572								
1972	1,639								
1974	1,661								
1976	1,615								
1978	1.613								
1980	3,395								
1982	4,026								
1984	5,141								
1986	6,076								
1988	6,235								
1990	7,523								
Projections									
1991		7,191	6,730	6,858	6,286	7,218	6,760	6,749	6,170
1992		7,429	6,985	7,012	6,466	7,563	7,135	7,012	6,466
1993		7,666	7,240	7,165	6,645	7,909	7,510	7,274	6,762
1994		7,904	7,495	7,319	6,825	8,254	7,886	7,537	7,057
1995		8,141	7,750	7,472	7,004	8,599	8,261	7,799	7,353
1996		8,379	8,005	7,626	7,184	8,944	8,636	8,062	7,649
1997		8,616	8,260	7,779	7,364	9,290	9,012	8,324	7,945
1998		8,854	8,515	7,933	7,543	9,635	9,387	8,587	8,241
1999		9,091	8,770	8,087	7,723	9,980	9,762	8,849	8,537
2000		9,329	9,025	8,240	7,903	10,325	10,138	9,112	8,833
2001		9,566	9,280	8,394	8,082	10,670	10,513	9,374	9,129
2002		9,804	9,535	8,547	8,262	11,016	10,888	9,637	9,425
2003		10,041	9,790	8,701	8,441	11,361	11,263	9,899	9,721
2004		10,279	10,045	8,854	8,621	11,706	11,639	10,162	10,017
2005		10,516	10,300	9,008	8,801	12,051	12,014	10,425	10,312
2006		10,754	10,555	9,162	8,980	12,397	12,389	10,687	10,608
2007		10,991	10,810	9,315	9,160	12,742	12,765	10,950	10,904
2008		11,229	11,065	9,469	9,339	13,087	13,140	11,212	11,200
2009		11,466	11,319	9,622	9,519	13,432	13,515	11,475	11,496
2010		11,704	11,574	9,776	9,699	13,777	13,890	11,737	11,792

Source: Historical acreage from Commercial Citrus Inventory 1966-1990, Florida Agricultural Statistics Service.

TABLE G-31. Historical and Projected Citrus Acreage in Glades County.

Year	Historical	Primary projection	Primary -15 %	Primary + 15 %
1966	1,413			
1968	1,461			
1970	1,572			
1972	1,639			
1974	1,661			
1976	1,615			
1978	1,613			
1980	3,395			
1982	4,026			
1984	5,141			
1986	6,076			
1988	6,235			
1990	7,523			
Projections				
1991		7,868	6,688	9,048
1992		8,213	6,981	9,445
1993		8,559	7,275	9,843
1994		8,904	7,568	10,240
1995		9,249	7,862	10,636
1996		9,594	8,155	11,033
1997		9,940	8,449	11,431
1998		10,285	8,742	11,828
1999		10,630	9,036	12,224
2000		10,975	9,329	12,621
2001		11,320	9,622	13,018
2002		11,666	9,916	13,416
2003		12,011	10,209	13,813
2004		12,356	10,503	14,209
2005		12,701	10,796	14,606
2006		13,047	11,090	15,004
2007		13,392	11,383	15,401
2008		13,737	11,676	15,798
2009		14,082	11,970	16,194
2010		14,427	12,263	16,591

Source: Historical acreage from Commercial Citrus Inventory 1966-1990, Florida Agricultural Statistics Service.

Citrus Irrigation Requirements. In October 1989, permitted citrus acreage in Glades County had irrigation systems in the ratio shown in Table G-32. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Moore Haven on 0.8 inch soil are shown in Table G-33.

TABLE G-32. Ratio of Permitted Irrigation System Type on Citrus in Glades County.

Type of System	Percent of Permitted Citrus	Estimated Irrigation Efficiency
Micro-irrigation	77 percent	0.85
Overhead sprinkler	3 percent	0.75
Seepage	20 percent	0.50

Source: District Water Supply Planning Permit Database.

TABLE G-33. Supplemental Water Requirements for Citrus in Glades County.

Month	Average (in.)	2-in-10 (in.)
January	1.58	1.70
February	1.52	1.66
March	2.16	2.33
April	2.64	2.86
May	2.79	3.14
June	1.76	2.34
July	2.24	2.80
August	2.42	2.93
September	1.52	2.05
October	2.12	2.38
December	2.27	1.92
TOTAL	24.86	28.53

Rainfall station = Moore Haven.
Soil type = 0.8 inch.

The supplemental water requirements in Table G-33 were divided by irrigation efficiency to yield irrigation requirements. Average and 2-in-10 irrigation requirements for the primary projection are shown in Table G-34.

TABLE G-34. Irrigation Requirements in Millions of Gallons for the Primary Citrus Acreage Projection in the Glades County Area.

Average	1985	1990	1995	2000	2005	2010
January	208	256	316	368	419	471
February	200	247	304	354	403	453
March	284	350	433	503	573	643
April	348	428	529	615	701	786
May	367	453	559	650	740	831
June	232	286	353	410	467	524
July	295	363	449	522	594	667
August	319	393	485	563	642	721
September	200	247	304	354	403	453
October	279	344	425	494	563	632
299	299	368	455	529	602	676
December	241	297	367	426	486	545
TOTAL	3,272	4,031	4,977	5,786	6,594	7,403
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	224	276	341	396	451	506
February	219	269	332	386	441	495
March	307	378	467	542	618	694
April	377	464	573	666	759	852
May	413	509	629	731	833	935
June	308	380	469	545	621	697
July	369	454	561	652	743	834
August	386	475	587	682	778	873
September	270	333	411	477	544	611
October	319	393	485	563	642	721
November	313	386	477	554	632	709
December	253	311	385	447	509	572
TOTAL	3,757	4,628	5,714	6,643	7,571	8,499
Irrigated Acreage	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
County	5,609	7,523	9,249	10,975	12,701	14,427
County Area	3,309	4,439	5,457	6,475	7,494	8,512
% in LWC	59%	59%	59%	59%	59%	59%

Charlotte County Area

Citrus Acreage. A variety of variables and functional forms were tested, and models of the general form of Equation (G-28) were found to best explain past trends in citrus acreage in Charlotte County, as was the case in Glades County.

$$CHCIT_t = f(time, D, RP_p, RP_w, RP_o) \quad \textbf{(G-28)}$$

where:
$CHCIT_t$ = *citrus acreage in Charlotte County in year t.*
RP_p, RP_w, *and* RP_o = *the real prices of Interior Region pink and white grapefruit and oranges respectively.*
D = *a dichotomous variable equal to 0 before 1984 and 1 in the period 1984 and after.*

The dichotomous variable corresponds closely to the onset of the series of severe winters in recent years, similar to Glades County, the D variable picks up a portion of the interregional shift in citrus production within Florida. Models were run which weighted all observations equally and with the weight assigned to a particular observation declining geometrically with time, with the lowest weight being assigned to the earliest observation. Weighted Charlotte citrus acreage is denoted as $WCHCIT_t$. Eight specific sub-models were estimated as shown in equations (G-29) through (G-36).

$$CHCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \text{(G-29)}$$

$$WCHCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \text{(G-30)}$$

$$CHCIT_t = f(time, D) \quad \text{(G-31)}$$

$$WCHCIT_t = f(time, D) \quad \text{(G-32)}$$

$$CHCIT_t = f(time, RP_p, RP_o, RP_w) \quad \text{(G-33)}$$

$$WCHCIT_t = f(time, RP_p, RP_w, RP_o) \quad \text{(G-34)}$$

$$CHCIT_t = f(time) \quad \text{(G-35)}$$

$$WCHCIT_t = f(time) \quad \text{(G-36)}$$

Functional forms (G-29) through (G-36) were estimated using ordinary least squares regression, resulting in equations (G-37) through (G-44).

$$CHCIT_t = \underset{}{3798.387} + \underset{(1.80)}{54.70814} * time - \underset{(-1.18)}{859.3431} * RP_w - \underset{(-2.33)}{280.8888} * RP_o + \underset{(1.69)}{1450.652} * RP_p + \underset{(4.98)}{2185.069} * D \quad \text{(G-37)}$$

Goodness of fit statistics
$R^2 = .9475$
$F = 21.67$
$Pr\,F>0>.999$
$D\text{-}W = 2.708$
t - statistics in parentheses

$$WCHCIT_t = \underset{}{764.5834} + \underset{(5.17)}{328.3388} * time + \underset{(1.29)}{1973.772} * RP_w - \underset{(-2.10)}{528.362} * RP_o - \underset{(-0.80)}{1423.541} * RP_p + \underset{(1.64)}{1506.609} * D \quad \text{(G-38)}$$

Goodness of fit statistics
$R^2 = .9507$
$F = 23.14$
$Pr\,F>0>.999$
$D\text{-}W = 2.441$
t - statistics in parentheses

$$CHCIT_t = 5897.75 + 33.25 * time + 2178.667 * D \quad \text{(G-39)}$$
$$(1.02) \qquad (4.19)$$

Goodness of fit statistics
$R^2 = .8651$
$F = 28.85$
$Pr\ F>0>.999$
$D\text{-}W = 0.9491$
t - statistics in parentheses

$$WCHCIT_t = -215.7632 + 296.627 * time + 1234.235 * D \quad \text{(G-40)}$$
$$(4.89) \qquad (1.28)$$

Goodness of fit statistics
$R^2 = .8997$
$F = 40.35$
$Pr\ F>0>.999$
$D\text{-}W = 2.267$
t - statistics in parentheses

$$CHCIT_t = 565.0319 + 168.7962 * time - 1634.997 * FP_w - 136.627 * RP_o + 2443.092 * RP_p \quad \text{(G-41)}$$
$$(4.01) \qquad (1.09) \qquad (-0.56) \qquad (1.40)$$

Goodness of fit statistics
$R^2 = .7303$
$F = 4.74$
$Pr\ F>0=.964$
$D\text{-}W=1.441$
t - statistics in parentheses

$$WCHCIT_t = 1464.821 + 407.00027 * time + 1438.957 * RP_w - 428.8932 * RP_o - 739.2515 * Rp_p \quad \text{(G-42)}$$
$$(8.72) \qquad (0.86) \qquad (-1.58) \qquad (-0.38)$$

Goodness of fit statistics
$R^2 = .9285$
$F = 22.71$
$Pr\ F>O>.999$
$D\text{-}W = 1.532$
t - statistics in parentheses

$$CHCIT_t = 5208.347 + 136.0089 * time \quad \text{(G-43)}$$
$$(3.89)$$

Goodness of fit statistics
$R^2 = .6020$
$F = 15.12$
$Pr\ F>O = .997$
$D\text{-}W = .8554$
t - statistics in parentheses

$$WCHCIT_t = 606.3165 + 354.8663 * time \quad (8.62) \qquad \text{(G-44)}$$

Goodness of fit statistics
$R^2 = .8815$
$F = 74.37$
$Pr\,F>O>.999$
$D\text{-}W = 1.498$
t - statistics in parentheses

When equations (G-37) through (G-44) were used to project Charlotte County citrus acreage, the results shown in columns (G-37) through (G-44) in Table G-35 were obtained.

On the basis of the recent growth in citrus acreage, it was observed that all models underestimated 1990 citrus acreage. To overcome this deficiency, the projection by Equation (G-42) was selected, and future projections were adjusted by the amount by which 1990 acreage was underestimated (2,751 acres). This is equivalent to inserting a dichotomous intercept-shift variable into the model for the period 1990 and after. When this adjustment was made, the primary projection shown in Table G-36 was obtained. Table G-36 shows the historical and projected citrus acreage in Charlotte County as a whole. To generate estimates of citrus acreage in the Charlotte County Area it was assumed that changes is citrus acreage will be proportional to the current acreages within the two districts.

It was estimated from SFWMD and SWFWMD permit data that approximately 15 percent of the citrus acreage in Charlotte County currently lies within the SFWMD. Citrus acreage projections for the Charlotte County Area were based on this ratio. The estimated citrus acreages for Charlotte County and the Charlotte County Area for the six time horizons are shown in Table G-37.

Citrus Irrigation Requirements. All citrus permitted by the District in August 1990 in the Charlotte County Area was permitted for micro irrigation, and all future citrus is anticipated to be irrigated with similar systems. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in La Belle on 0.8 inch soil are shown in Table G-38.

Table G-38 shows the supplemental water requirement by month for citrus in the Charlotte County Area. Average and 2-in-10 irrigation requirements were calculated for the primary proje ction, and are shown in Table G-39.

TABLE G-35. Alternative Model Projections for Citrus Acreage in Charlotte County.

Year	Historical	Column (E-37)	Column (E-38)	Column (E-39)	Column (E-40)	Column (E-41)	Column (E-42)	Column (E-43)	Column (E-44)
1966	5,048								
1968	6,052								
1970	6,734								
1972	6,640								
1974	6,549								
1976	6,408								
1978	6,100								
1980	6,122								
1982	6,120								
1984	8,220								
1886	8,759								
1988	9,345								
Projections									
1989		8,873	9,690	8,874	8,138	6,189	8,560	8,474	7,911
1990		8,928	10,018	8,908	8,434	6,358	8,967	8,611	8,266
1991		8,983	10,347	8,941	8,731	6,527	9,374	8,747	8,621
1992		9,037	10,675	8,974	9,027	6,695	9,781	8,883	8,976
1993		9,092	11,003	9,007	9,324	6,864	10,188	9,019	9,330
1994		9,147	11,332	9,041	9,621	7,033	10,595	9,155	9,685
1995		9,201	11,660	9,074	9,917	7,202	11,002	9,291	10,040
1996		9,256	11,988	9,107	10,214	7,371	11,409	9,427	10,395
1997		9,311	12,317	9,140	10,511	7,539	11,816	9,563	10,750
1998		9,366	12,645	9,174	10,807	7,708	12,223	9,699	11,105
1999		9,420	12,973	9,207	11,104	7,877	12,630	9835	11,460
2000		9,475	13,302	9,240	11,400	8,046	13,037	9,971	11,815
2001		9,530	13,630	9,273	11,697	8,215	13,444	10,108	12,170
2002		9,584	13,958	9,307	11,994	8,383	13,851	10,244	12,524
2003		9,639	14,287	9,340	12,290	8,552	14,258	10,380	12,879
2004		9,694	14,615	9,373	12,587	8,721	14,665	10,516	13,234
2005		9,749	14,943	9,406	12,884	8,890	15,072	10,652	13,589
2006		9,803	15,272	9,440	13,180	9,058	15,479	10,788	13,944
2007		9,858	15,600	9,473	13,477	9,227	15,886	10,924	14,299
2008		9,913	15,928	9,506	13,773	9,396	16,293	11,060	14,654
2009		9,967	16,257	9,539	14,070	9,565	16,700	11,196	15,009
2010		10,022	16,585	9,573	14,367	9,734	17,107	11,332	15,364

Source: Historical acreage from Commercial Citrus Inventory 1966-1990, Florida Agricultural Statistics Service.

TABLE G-36. Historical and Projected Citrus Acreage in Charlotte County.

Year	Historical	Primary Projection	Primary-15 %	Primary+15 %
1966	5,048			
1968	6,052			
1970	6,734			
1972	6,640			
1974	6,549			
1976	6,408			
1978	6,100			
1980	6,122			
1982	6,120			
1984	8,220			
1986	8,759			
1988	9,345			
1990	11,718			
Projections				
1991		12,125	10,306	13,944
1992		12,532	10,652	14,412
1993		12,939	10,998	14,880
1994		13,346	11,344	15,348
1995		13,753	11,690	15,816
1996		14,160	12,036	16,284
1997		14,567	12,382	16,752
1998		14,974	12,728	17,220
1999		15,381	13,074	17,688
2000		15,788	13,420	18,156
2001		16,195	13,766	18,624
2002		16,602	14,112	19,092
2003		17,009	14,458	19,560
2004		17,416	14,804	20,028
2005		17,823	15,150	20,496
2006		18,230	15,496	20,965
2007		18,637	15,841	21,433
2008		19,044	16,187	21,901
2009		19,451	16,533	22,369
2010		19,858	16,879	22,837

Source: Historical acreage from Commercial Citrus Inventory 1966-1990, Florida Agricultural Statistics Service.

TABLE G-37. Historical and Projected Citrus Acreage in the Charlotte County Area.

	1985	1990	1995	2000	2005	2010
Charlotte County	8,490	11,718	13,753	15,788	17,823	19,858
Charlotte County Area	1,274	1,758	2,063	2,368	2,673	2,979

TABLE G-38. Supplemental Water Requirements for Citrus in the Charlotte County Area.

Month	Average (in.)	2-in-10 (in.)
January	1.58	1.69
February	1.41	1.56
March	2.07	2.26
April	2.68	2.89
May	3.12	3.41
June	1.43	2.03
July	2.05	2.61
August	2.16	2.68
September	1.50	2.00
October	2.23	2.49
November	2.31	2.40
December	1.75	1.84
TOTAL	24.29	27.86

Rainfall Station = La Belle.
Soil Type = 0.8 inch.

TABLE G-39. Irrigation Requirements in Millions of Gallons for the Primary Citrus Acreage Projection in the Charlotte County Area.

Average	1985	1990	1995	2000	2005	2010
January	64	89	104	120	135	150
February	57	79	93	107	120	134
March	84	116	136	157	177	197
April	109	150	177	203	229	255
May	127	175	206	236	266	297
June	58	80	94	108	122	136
July	83	115	135	155	175	195
August	88	121	142	163	184	206
September	61	84	99	113	128	143
October	91	125	147	169	190	212
November	94	130	152	175	197	220
December	71	98	115	132	149	167
TOTAL	988	1,364	1,601	1,838	2,075	2,312
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	69	95	111	128	144	161
February	63	88	103	118	133	148
March	92	127	149	171	193	215
April	118	162	190	219	247	275
May	139	191	225	258	291	325
June	83	114	134	154	173	193
July	106	147	172	197	223	248
August	109	150	177	203	229	255
September	81	112	132	151	171	190
October	101	140	164	188	213	237
November	98	135	158	182	205	228
December	75	103	121	139	157	175
TOTAL	1,134	1,564	1,836	2,108	2,380	2,651

Sugarcane

Sugarcane is grown commercially in Hendry and Glades counties. Projections of sugarcane acreage in both these counties were developed using trend analysis.

Sugarcane is initially propagated vegetatively by planting stalk cuttings. The first harvest takes place approximately 13 months after planting. Roots are left in the ground (ratooned) and yield additional crops of sugarcane which take about 12 months to reach maturity. Sugar production per acre declines gradually and progressively with each additional ratoon, and there comes a point where the increased yields associated with replanting outweigh the cost of replanting. In Florida, this point comes on average after four years (1 planting and 3 ratoons).

After the final ratoon in the cycle is harvested on a parcel of land (from November through March), and before replanting takes place (from September through January), there is no sugarcane on that parcel. The land is invariably fallowed during this period. This means that there is on average 20 percent of land associated with sugarcane production that will be in fallow and not reported as production by FASS. This 20 percent of land will not require irrigation and is not included in the demand projections presented here.

Historical sugarcane acreage data were gathered from annual volumes of the Field Crops Summary (Florida Department of Agricultural and Consumer Services, 1975-1990). A variety of variables and functional forms were tested. Two models which performed well, based on ability to explain past trends in sugarcane acreage, are shown in equations (G-45) and (G-46).

$$A_{jt} = a + b_1 * t + b_2 * D \qquad \text{(G-45)}$$

$$A_{jt} = a + b_1 * P_{re} + b_2 * t + b_3 * t * D \qquad \text{(G-46)}$$

where:
A_{jt} = *sugarcane acreage in area j in time t.*
t = *a linear trend variable.*
P_{re} = *the real price of sugarcane received by farmers.*
D = *a 0-1 variable; 0 prior to 1985; 1 after 1985.*

Hendry County Area

Sugarcane Acreage. The projections obtained using functional forms (G-45) and (G-46) are shown in columns (G-48) and (G-49) in Table G-40. Column (G-48) shows sugarcane acreage projections for Hendry County estimated as a linear function of time with the inclusion of a 0-1 dichotomous variable. This dichotomous variable took the value of 0 prior to 1985 and a value of 1 in 1985 and after. For projection purposes, the dichotomous variable was set equal to 1. Equation (G-45) estimated by ordinary least squares is shown as Equation (G-47).

$$A_{sht} = 44423.24 + \underset{(7.96)}{2882.953 * t} - \underset{(-6.00)}{20711.17 * D} \qquad \text{(G-47)}$$

where:
A_{sht} = *estimated sugarcane acreage in Hendry County in year t.*
t = *a trend variable taking on a value of 1 in 1975 and increasing by one unit per year.*
D = *a dichotomous variable taking on a value of 0 prior to 1985 and a value of 1 after 1985.*

Goodness of fit statistics
$R^2 = .8331$
$F = 32.44$
$Pr F > 0 > .999$
$D - W = 2.663$
t - statistics are in parentheses

For projection purposes, D was set equal to 1, so the reduced form equation used for projection purposes is given by Equation (G-48).

$$A_{sht} = 23712.07 + 2882.953 * t \qquad \text{(G-48)}$$

The estimated equation of functional form (G-46) is given by Equation (G-49), from which column (G-49) was derived. In Equation (G-49) sugarcane acreage was estimated as a function of the real price of sugarcane, a trend variable, and an interaction term between the trend variable and the dichotomous variable.

$$A_{sht} = \underset{}{49641.03} - \underset{(-0.82)}{496.191 * P_{re}} + \underset{(6.31)}{2905.534 * t} - \underset{(-5.04)}{1595.181 * t * D} \qquad \text{(G-49)}$$

where:
P_{re} = *the average annual price of sugar received by farmers, deflated by the consumer price index.*
All other variables are as previously defined.

Goodness of fit statistics
$R^2 = .7981$
$F = 15.82$
$Pr F > 0 > .999$
$D-W = 3.616$
t - statistics are in parentheses

For the projections, the value of D was set equal to 1, and P_{re} was held at its 1989 level.

Equation (G-49), adjusted for the difference between estimated and actual acreage for 1990, was selected to project sugarcane acreage in Hendry County since it performed well in explaining past observed sugarcane acreage, and was believed to produce likely values for future acreages. On the advise of the local IFAS extension office, projected acreage was capped at 85,000 acres to reflect the limitation of transportation costs combined with the appeal of alternative crops. The primary projection ($\pm$ 15%) is shown in Table G-40.

Sugarcane Irrigation Requirements. There are two basic soil types on which sugarcane is grown in Hendry County, i.e., muck and sand. Presently there are approximately 35,000 acres of sugarcane produced annually on muck in Hendry

TABLE G-40. Historical and Projected Sugarcane Acreage in Hendry County.

Year	Historical	Column (G-48)	Column (G-49)	Primary Projection	Primary -15 %	Primary +15 %
1975	50,637					
1976	52,545					
1977	51,579					
1978	53,314					
1979	57,217					
1980	58,173					
1981	62,476					
1982	72,750					
1983	69,281					
1984	74,923					
1985	56,571					
1986	58,257					
1987	61,720					
1988	62,525					
1989	60,252					
1990	76,467	69,839	66,505			
Projectionss						
1991		72,722	67,816	77,778	66,111	89,445
1992		75,605	69,126	79,088	67,225	90,951
1993		78,488	70,436	80,398	68,338	92,458
1994		81,371	71,747	81,709	69,453	93,965
1995		84,254	73,057	83,019	70,566	95,472
1996		87,137	74,367	84,329	71,680	96,978
1997		90,020	75,678	85,000	72,250	97,750
1998		92,903	76,988	85,000	72,250	97,750
1999		95,786	78,298	85,000	72,250	97,750
2000		98,669	79,609	85,000	72,250	97,750
2001		101,552	80,919	85,000	72,250	97,750
2002		104,435	82,229	85,000	72,250	97,750
2003		107,318	83,540	85,000	72,250	97,750
2004		110,201	84,850	85,000	72,250	97,750
2005		113,084	86,160	85,000	72,250	97,750
2006		115,967	87,471	85,000	72,250	97,750
2007		118,850	88,781	85,000	72,250	97,750
2008		121,733	90,092	85,000	72,250	97,750
2009		124,615	91,402	85,000	72,250	97,750
2010		127,498	92,712	85,000	72,250	97,750

Source: Historical acreage from Field Crops Summary 1975-1990, Florida Agricultural Statistics Service.

County. This area is almost entirely within the LEC portion of Hendry County; therefore irrigation requirements for the LWC portion of the county were calculated for sandy soil. The area of sugarcane production on muck is anticipated to remain constant over the projection period, and all expansion in sugarcane acreage is expected to take place on sand. The average and 2-in-10 supplemental water requirements for sugarcane at the rainfall station in La Belle for sandy soil are shown in Table G-41.

TABLE G-41. Supplemental Water Requirements for Sugarcane in Hendry County.

Soil Type	Sand 0.8 (in.) Average (in.)	Sand 0.8 (in.) 2-in-10 (in.)
January	0.72	0.82
February	0.14	0.27
March	1.38	1.56
April	2.19	2.39
May	3.05	3.35
June	1.92	2.54
July	2.57	3.15
August	3.01	3.55
September	1.67	2.18
October	3.30	3.58
November	2.52	2.61
December	1.93	2.02
Total	**24.40**	**28.02**

Rainfall station = La Belle.

Historical and projected acreage of sugarcane in the Hendry County Area was taken as 61 percent of the whole county's acreage presented in Table G-42. This ratio was assessed using GIS analysis and is described later in the text. It remains constant over the projection period. Sugarcane is assumed to use seepage irrigation, with an irrigation efficiency of 50 percent. Irrigation requirements were calculated using Equation (G-8).

Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-42.

TABLE G-42. Irrigation Requirements in Millions of Gallons for the Primary Sugarcane Acreage Projection in the Hendry County Area.

Average	1985	1990	1995	2000	2005	2010
January	1,349	1,824	1,980	2,028	2,028	2,018
February	262	355	385	394	394	394
March	2,586	3,496	3,795	3,886	3,886	3,886
April	4,105	5,548	6,023	6,167	6,167	6,167
May	5,716	7,727	8,388	8,589	8,589	8,589
June	3,598	4,864	5,281	5,407	5,407	5,407
July	4,817	6,511	7,068	7,237	7,237	7,237
August	5,641	7,625	8,278	8,476	8,476	8,476
September	3,130	4,231	4,593	4,703	4,703	4,703
October	6,185	8,360	9,076	9,293	9,293	9,293
November	4,723	6,384	6,931	7,097	7,097	7,097
December	3,617	4,889	5,308	5,435	5,435	5,435
TOTAL	45,731	61,814	67,107	68,712	68,712	68,712

2-in-10	1985	1990	1995	2000	2005	2010
January	1,537	2,077	2,255	2,309	2,309	2,309
February	506	684	743	760	760	760
March	2,924	3,952	4,290	4,393	4,393	4,393
April	4,479	6,055	6,573	6,730	6,730	6,730
May	6,279	8,487	9,213	9,434	9,434	9,434
June	4,761	6,435	6,986	7,153	7,153	7,153
July	5,904	7,980	8,663	8,871	8,871	8,871
August	6,653	8,993	9,763	9,997	9,997	9,997
September	4,086	5,523	5,996	6,139	6,139	6,139
October	6,710	9,069	9,846	10,082	10,082	10,082
November	4,892	6,612	7,178	7,350	7,350	7,350
December	3,786	5,117	5,556	5,688	5,688	5,688
TOTAL	52,516	70,985	77,063	78,906	78,906	78,906

Irrigated Acreage	1985	1990	1995	2000	2005	2010
County	56,571	76,467	83,014	85,000	85,000	85,000
County Area	34,508	34,508	50,639	51,850	51,850	51,850
% in LWC	61%	61%	63%	61%	61%	61%

Glades County Area

Sugarcane Acreage. The projections obtained using functional forms (G-45) and (G-46) are shown in equations and columns (G-51) and (G-52). Column (G-51) in Table G-43 shows sugarcane acreage projections for Glades County estimated as a linear function of time with the inclusion of a 0-1 dichotomous variable. This dichotomous variable took the value of 0 prior to 1985 and a value of 1 in 1985 and after. For projection purposes, the dichotomous variable was set equal to 1. The functional form (G-45) estimated by ordinary least squares is shown as Equation (G-50).

$$A_{sgt} = 15215.53 + 971.423 * t - 9520.366 * D \quad \textbf{(G-50)}$$
$$(8.54) \qquad (-8.79)$$

where:
A_{sgt} = *estimated sugarcane acreage in Glades County in year t.*
t = *a trend variable taking on a value of 1 in 1975 and increasing by one unit per year.*
D = *a dichotomous variable taking on a value of 0 prior to 1985 and a value of 1 after 1985.*

Goodness of fit statistics
$R^2 = .8628$
$F = 40.87$
$Pr\, F > 0 > .999$
t - statistics are in parentheses

For projection purposes, D was set equal to 1, so the reduced form equation used for projection purposes is given by Equation (G-51).

$$A_{sgt} = 5695.16 + 971.423 * t \quad \textbf{(G-51)}$$

The estimated equation of functional form (G-46) is given by Equation (G-52), from which column (G-52) was derived. In Equation (G-52) sugarcane acreage was estimated as a function of the real price of sugarcane, a trend variable, and an interaction term between the trend variable and the dichotomous variable.

$$A_{sgt} = 16530.28 - 147.801 * P_{re} + 1020.495 * t - 747.184 * t * D \quad \textbf{(G-52)}$$
$$(0.77) \qquad (7.01) \qquad (-7.47)$$

where:
P_{re} = *the average annual price of sugar received by farmers, deflated by the consumer price index.*
All other variables are as previously defined.

Goodness of fit statistics
$R^2 = .8319$
$F = 19.80$
$Pr\, F > 0 > .999$
t - statistics are in parentheses

For the projections, the value of D was set equal to 1, and P_{re} was held at its 1989 level. Projections resulting from equations (G-51) and (G-52) were averaged and adjusted to reflect the difference between the average and the actual acreage for 1990. This amounted to subtracting 826 acres from the average for years after 1990, to yield the primary projection for sugarcane acreage in Glades County. The primary projection ($\pm$15%) is shown in Table G-43.

Sugarcane Irrigation Requirements. All of the sugarcane grown in Glades County is in the LWC Planning Area. Sugarcane is grown on both muck and sand in the Glades County Area. Presently, there are about 13,000 acres of sugarcane produced annually on muck. This area of sugarcane production on muck is expected to remain constant over the projection period, and all change in sugarcane acreage is expected to take place on sand. The average and 2-in-10 supplemental water requirements for sugarcane on the two soil types at the rainfall station in Moore Haven is shown in Table G-44.

Historical and projected acreage of sugarcane in Glades County was taken from Table G-43. Sugarcane is assumed to use seepage irrigation, with an irrigation efficiency of 50 percent. Irrigation requirements were calculated using Equation (G-8). Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-45.

TABLE G-43. Historical and Projected Sugar Cane Acreage in Glades County.

Year	Historical	Column (G-51)	Column (G-52)	Average	Primary Projection	Primary -15 %	Primary +15 %
1975	16,636						
1976	18,545						
1977	16,842						
1978	18,294						
1979	19,494						
1980	20,096						
1981	22,908						
1982	23,904						
1983	22,924						
1984	26,015						
1985	15,559						
1986	17,165						
1987	20,020						
1988	20,321						
1989	20,119						
1990	19,633	21,237	19,680	20,459	19,633		
Projections							
1991		22,208	19,953	21,081	20,255	17,217	23,293
1992		23,178	20,226	21,702	20,877	17,745	24,008
1993		24,149	20,498	22,324	21,498	18,273	24,723
1994		25,120	20,771	22,946	22,120	18,802	25,438
1995		26,091	21,044	23,568	22,742	19,331	26,153
1996		27,062	21,316	24,189	23,364	19,859	26,868
1997		28,033	21,589	24,811	23,986	20,388	27,583
1998		29,004	21,862	25,433	24,608	20,916	28,299
1999		29,975	22,134	26,055	25,229	21,445	20,013
2000		30,946	22,407	26,677	25,851	21,973	29,729
2001		31,917	22,680	27,299	26,473	22,502	30,444
2002		32,888	22,952	27,920	27,095	23,030	31,159
2003		33,858	23,225	28,542	27,716	23,559	31,873
2004		34,829	23,498	29,164	28,338	24,087	32,589
2005		35,800	23,770	29,785	28,960	24,616	33,303
2006		36,771	24,043	30,407	29,582	25,144	34,019
2007		37,742	24,316	31,029	30,204	25,673	34,734
2008		38,713	24,588	31,651	30,825	26,201	35,449
2009		39,684	24,861	32,273	31,447	26,730	36,164
2010		40,655	25,134	32,895	32,069	27,259	36,879

Source: Historical acreage from Field Crops Summary 1975-1990, Florida Agricultural Statistics Service.

TABLE G-44. Supplemental Water Requirements for Sugarcane in Glades County.

Soil Type	Sand 0.8 (in.) Average (in.)	Sand 0.8 (in.) 2-in-10 (in.)	Muck 3.6 (in.) Average (in.)	Muck 3.6(in.) 2-in-10 (in.)
January	0.73	0.84	0.45	0.60
February	0.26	0.39	0.00	0.10
March	1.47	1.64	1.02	1.26
April	2.16	2.37	1.60	1.90
May	2.73	3.08	1.80	2.29
June	2.25	2.86	0.67	1.50
July	2.77	3.35	1.24	2.05
August	3.28	3.82	1.85	2.60
September	1.69	2.23	0.27	1.02
October	3.20	3.52	2.33	2.79
November	2.49	2.60	2.20	2.35
December	2.01	2.10	1.77	1.90
TOTAL	25.04	28.79	15.20	20.36

Rainfall station = Moore Haven.

TABLE G-45. Irrigation Requirements in Millions of Gallons for the Primary Sugarcane Acreage Projection in the Glades County Area.

Average	1985	1990	1995	2000	2005	2010
January	421	581	704	827	951	1,074
February	37	94	138	181	225	269
March	928	1,250	1,498	1,746	1,994	2,243
April	1,435	1,908	2,273	2,637	3,002	3,367
May	1,656	2,254	2,715	3,176	3,637	4,098
June	791	1,284	1,664	2,043	2,423	2,803
July	1,267	1,873	2,341	2,809	3,277	3,744
August	1,769	2,488	3,042	3,596	4,149	4,703
September	429	799	1,085	1,370	1,656	1,941
October	2,097	2,798	3,338	3,879	4,419	4,959
November	1,905	2,450	2,871	3,291	3,712	4,132
December	1,533	1,974	2,313	2,653	2,992	3,331
TOTAL	14,267	19,753	23,981	28,209	32,437	36,665

2-in-10	1985	1990	1995	2000	2005	2010
January	542	726	868	1,010	1,152	1,294
February	126	211	277	343	409	475
March	1,121	1,480	1,757	2,034	2,311	2,588
April	1,676	2,195	2,595	2,996	3,396	3,796
May	2,052	2,726	3,247	3,767	4,287	4,807
June	1,463	2,089	2,572	3,055	3,538	4,021
July	1,920	2,654	3,220	3,786	4,351	4,917
August	2,375	3,212	3,857	4,502	5,147	5,792
September	1,035	1,524	1,900	2,277	2,653	3,030
October	2,467	3,238	3,832	4,427	5,021	5,615
November	2,026	2,596	3,035	3,474	3,913	4,352
December	1,638	2,098	2,453	2,807	3,162	3,516
TOTAL	18,441	24,751	29,614	34,477	39,340	44,203

Tropical Fruit

With the exception of citrus, all categories of tropical fruit (avocados, mangoes, etc.) were grouped together for projection purposes. Lee is the only county in the LWC Planning Area with significant tropical fruit acreage.

Lee County

Tropical Fruit Acreage. In 1989 there were 1,630 acres of tropical fruit in Lee County (IFAS, University of Florida, 1989). There was not sufficient historical data to establish a statistically valid trend. However, the local IFAS extension office estimated that presently there typically is an increase in tropical fruit acreage of about 50 acres a year. This leads to estimates of tropical fruit acreage to be 1,430 acres in 1985, 1,680 acres in 1990, 1,930 acres in 1995, 2,180 acres in 2000, 2,430 acres in 2005, and 2,680 acres in 2010.

Tropical Fruit Irrigation Requirements. The District's Blaney-Criddle permitting model has no category for tropical fruit as a grouping, and the crop category of avocado was used to calculate irrigation requirements for all tropical fruit (avocados in 1990 made up over 80 percent of the permitted non-citrus tropical fruit acreage in Lee County).

In Lee County, 90 percent of the 1990 permitted tropical fruit acreage was permitted for seepage irrigation. This 90 percent represents one large permittee which produces the bulk of avocado in Lee County. Although the current acreage is mostly seepage irrigated, it is believed by the local IFAS extension office that future expansion will use micro irrigation.

All tropical fruit production was assumed to take place on soil with a usable soil water capacity of 0.8 inch. The average and 2-in-10 supplemental water requirements for avocado on 0.8 inch soil at the rainfall station in Fort Myers are shown in Table G-46.

TABLE G-46. Supplemental Water Requirements for Avocado in Lee County.

Month	Average (in.)	2-in-10 (in.)
January	0.19	0.31
February	0.62	0.76
March	1.84	1.99
April	2.98	3.15
May	3.73	4.02
June	2.09	2.72
July	2.40	2.99
August	2.05	2.60
September	0.97	1.49
October	1.53	1.78
November	1.29	1.38
December	0.49	0.59
TOTAL	20.18	23.78

Rainfall station = Fort Myers.
Soil type = 0.8 inch.

The irrigation requirement for 1985 was estimated by subtracting the 1985 acreage from the 1990 total, and assuming that all the tropical fruit irrigated using micro-irrigation in Lee County was planted between 1985 and 1990. Irrigation requirements for years future to 1990 were projected with the assumption that micro-irrigation will be used on all additional acreage. Average and 2-in-10 irrigation requirements for the primary tropical fruit acreage projections for Lee County are presented in Table G-47.

TABLE G-47. Irrigation Requirements in Millions of Gallons for the Primary Tropical Fruit Acreage Projection in Lee County.

Average	1985	1990	1995	2000	2005	2010
January	14	17	18	20	21	23
February	47	54	59	64	69	74
March	140	161	176	190	205	220
April	227	261	285	308	332	356
May	284	326	356	386	416	445
June	159	183	200	216	233	250
July	183	210	229	248	267	287
August	156	179	196	212	228	245
September	74	85	93	100	108	116
October	117	134	146	158	171	183
November	98	113	123	133	144	154
December	37	43	47	51	55	59
TOTAL	1,538	1,765	1,927	2,088	2,249	2,410

2-in-10	1985	1990	1995	2000	2005	2010
January	24	27	30	32	35	37
February	58	66	73	79	85	91
March	152	174	190	206	222	238
April	240	276	301	326	351	376
May	306	352	384	416	448	480
June	207	238	260	281	303	325
July	228	262	285	309	333	357
August	198	227	248	269	290	311
September	114	130	142	154	166	178
October	136	156	170	184	198	213
November	105	121	132	143	154	165
December	45	52	56	61	66	70
TOTAL	1,812	2,080	2,270	2,460	2,650	2,840

Vegetables

Vegetable crops were grouped together for projection purposes. This was validated by the lack of significant difference in the irrigation requirements of different types of vegetables cultivated in the LWC Planning Area, and the production practices used on vegetable farms (different types of vegetables are often grown interchangeably). Much of the vegetable land is double cropped, and as many of the acreage data sources report harvested production, these data had to be adjusted to reflect acres of land in production. This adjustment is described for each county, depending on the prevailing vegetable crops and production practices, to yield a row acreage subtotal, after which the following adjustments were made to yield the total land acreage used for vegetable production:

- Fifteen percent of the subtotal row was added to account for non-harvested acreage. An examination of historical planted versus harvested acreage for vegetable crops within south Florida showed that an average of 15 percent of the acreage cultivated is not harvested. As FASS presently only reports harvested acreage, this 15 percent needed to be added to reflect the non-harvested vegetable row acreage.

- Vegetable acreage data reported in the FASS Vegetable Summaries and by IFAS represent the estimated area of land in the production rows. The District's model for estimating irrigation requirements is based on total land acreage, which includes the land necessary for vegetable production, but not in rows (i.e., spaces between rows, irrigation furrows, etc.). Land in rows represents approximately 60 percent of this total land (personal communication 1991 with D. Pitts, Southwest Florida Research and Education Center, Immokalee, FL.), so the row acreage was divided by 0.6 to yield the total (land) acreage column.

There are a variety of vegetable crops grown in the LWC Planning Area. Vegetable fields are usually planted and harvested sequentially; therefore, some portion of the land acreage used for vegetable production is commonly vacant. This temporal area of vegetable land vacancy effects total irrigation requirement, but it is difficult to quantify. This is because many eventualities occur which change production timing. For instance, freezes may necessitate replanting, which would delay the spring growing season; or growers may enter into a contract to harvest vegetables in a particular time window, which would in turn determine their growing season. Also, as seepage irrigation is the predominant type of irrigation system used for vegetable production, some of these vacant fields are unavoidably irrigated, either in part or in whole. With these constraints in mind, generalized cultivation schedules were developed with the assistance of the local IFAS extension offices.

Vegetables are planted throughout the year, and crop ET values depend on planting dates. Average ET values were developed based on an average of Blaney-Criddle values with planting dates at the beginning of each month.

Collier County

Vegetable Acreage. Table G-48 shows historical vegetable acreage in Collier County. These data were assembled in the following manner:

- Acreage data for cucumbers, peppers, squash, tomatoes, and watermelons were gathered from FASS Vegetable Summaries. A default value for potatoes was estimated by the local IFAS vegetable extension agent.

- With the exception of watermelons and potatoes these acreages were divided by two (to reflect the two growing seasons), and summed to yield the subtotal (row), as shown in Table G-48. FASS reports acreage as acres of production (i.e., 10 acres of land cultivated twice a year is reported as 20 acres).

- To yield the total (row), fifteen percent was added to account for non-harvest acreage, and this number was divided by 0.6 to account for the land between rows.

TABLE G-48. Historical Vegetable Acreage in Collier County.

Year	Cucumbers	Peppers	Squash	Tomatoes	Double cropped /2 (row)	Water-melons	Potatoes*	Subtotal (row)	Total (row)	Total (land)
1989-90	1,300	5,200	700	13,750	10,475	4,700	1,600	16,775	19,291	32,152
1988-89	1,350	5,100	1,000	15,250	11,350	4,600	1,600	17,550	20,183	33,638
1987-88	1,350	4,800	1,100	14,560	10,905	4,000	1,600	16,505	18,981	31,635
1986-87	1,700	3,800	1,500	12,000	9,500	3,400	1,600	14,500	16,675	27,792
1985-86	2,100	3,100	1,700	9,400	8,150	3,500	1,600	13,250	15,237	25,396
1984-85	1,600	2,800	2,000	8,800	7,600	3,500	1,600	12,700	14,605	24,342
1983-84	1,900	3,000	1,900	8,650	7,725	3,100	1,600	12,425	14,289	23,815
1982-83	2,100	3,400	1,800	7,950	7,625	2,700	1,600	11,925	13,714	22,856
1981-82	2,500	3,800	1,550	7,510	7,680	2,500	1,600	11,780	13,547	22,578
1980-81	2,450	4,000	1,700	9,130	8,640	2,400	1,600	12,640	14,536	24,227
1979-80	2,350	4,050	1,550	7,235	7,593	2,150	1,600	11,343	13,044	21,740
1978-79	2,600	4,750	1,500	6,800	7,825	1,850	1,600	11,275	12,966	21,610
1977-78	3,050	6,250	1,550	6,630	8,740	1,350	1,600	11,690	13,443	22,406
1976-77	3,070	5,850	1,900	5,110	7,965	1,400	1,600	10,965	12,610	21,016
1975-76	3,700	5,050	1,050	4,380	7,090	1,200	1,600	9,890	11,374	18,956
1974-75	3,400	3,890	1,000	3,775	6,033	1,450	1,600	9,083	10,445	17,408
1973-74	2,450	3,500	520	3,230	4,850	1,700	1,600	8,150	9,373	15,621
1972-73	2,700	3,650	460	3,520	5,165	1,600	1,600	8,365	9,620	16,033
1971-72	2,850	2,930	460	3,400	4,820	2,590	1,600	9,010	10,362	17,269
1970-71	2,900	2,950	420	2,885	4,578	2,900	1,600	9,078	10,439	17,399
1969-70	2,750	2,430	520	3,240	4,470	2,300	1,600	8,370	9,626	16,043
1968-69	4,070	3,530	340	1,940	4,940	3,000	1,600	9,540	10,971	18,285
1967-68	3,600	2,630	450	2,000	4,340	2,700	1,600	8,640	9,936	16,560
1966-67	3,250	3,180	760	2,060	4,625	2,900	1,600	9,125	10,494	17,490

*Default value from local IFAS extension office.
Source: Historical acreage from Vegetable Summaries 1966-1967, Florida Agricultural Statistics Service.

No statistically valid trend was found which produced tangible projections over the planning horizon. Vegetable researchers at the local IFAS research station in Immokalee believe that vegetable production in Collier County has stabilized, and probably will remain steady in the future (personal communication 1991 with C. Vavrina, Southwest Florida Research and Education Center, Immokalee, FL.). The primary projection for vegetable acreage in Collier County was based on this empirical knowledge, and was projected to remain at its 1990 level of 32,152 acres. The primary range is from 27,329 acres to 36,975 acres.

Vegetable Irrigation Requirements. The generalized cultivation schedule shown in Table G-49 was developed for 1988 with the assistance of the local IFAS extension office.

For the calculation of irrigation requirements, data from the Naples rainfall station on 0.4 inch soil were used. Table G-50 shows the supplemental water requirements, the estimated percentage of vegetable land in production in any given month (from Table G-49) and the irrigation requirements for vegetables in Collier County.

Example

Average irrigation requirements for vegetables in December 1995.

Assumptions:

- Primary projected area used for vegetable production for Collier County in 1995 = 32,152 acres.
- 40% of vegetable land in use in December (Table G-49).
- Irrigation efficiency = 50%.

Calculation:

The average irrigation requirement for vegetables in December is:

(((2.12 in./0.50) * 32,152 ac.) * 0.4) / 12 inches = 4,544 ac.ft.
(4,544 ac.ft. x 325,872 gal/ac.ft.) / 1,000,000 = 1,481 mg.

TABLE G-49. Generalized Cultivation Schedule for Vegetable Crops in Collier County.

Crop	Acres pro-duced	Crops per year	Acres of land	Jan *	% tot land **	Feb *	% tot land **	Mar *	% tot land **	Apr *	% tot land **	May *	% tot land **
Tomatoes	14,560	2	7,280	50	22	100	44	100	44	100	44	50	22
Cucumbers	1,350	2	675	50	2	100	4	100	4	100	4	50	2
Squash	1,100	2	550	50	2	100	3	100	3	100	3	50	2
Peppers	4,800	2	2,400	50	7	100	15	100	15	100	15	50	7
Potatoes	1,600	1	1,600	100	10	100	10	66	6	33	3	0	0
Watermelons	4,000	1	4,000	50	12	100	24	100	24	100	24	50	12
TOTAL	27,410		16,505		55 ***		100 ***		97 ***		94 ***		45 ***

TABLE G-49. (Continued).

Crop	Jun *	% tot land **	Jul *	% tot land **	Aug *	% tot land **	Sep *	% tot land **	Oct *	% tot land **	Nov *	% tot land	Dec *	% tot land **
Tomatoes	0	0	0	0	50	22	100	44	100	44	100	44	50	22
Cucumbers	0	0	0	0	50	2	100	4	100	4	100	4	50	2
Squash	0	0	0	0	50	2	100	3	100	3	100	3	50	2
Peppers	0	0	0	0	50	7	100	15	100	15	100	15	50	7
Potatoes	0	0	0	0	0	0	0	0	100	10	100	10	100	10
Watermelons	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		0 ***		0 ***		33 ***		66 ***		76 ***		76 ***		43.

* Percentage of land dedicated to relevant crop which is actually in the ground in that total particular month.

** Land dedicated to relevant crop to vegetable production (percentage).

*** Weighted average percent of vegetable land acreage which is actually in production during the relevant month.

TABLE G-50. Supplemental Water Requirements and Irrigation Requirements for Vegetable Crops in Collier County.

Month	Supplemental Water Requirements		Approx % in ground	1985 Irrigation Requirements Acreage=24,342		1990 to 2010 Irrigation Requirements Acreage=32,152	
	Avg.2-in-10 (in.)	Avg.2-in-10 (in.)		Avg. 2-in-10 (mg)	Avg.2-in-10 (mg)	Avg. 2-in-10 (mg)	Avg.2- in-10 (mg)
January	1.89	1.97	60	1,499	1,565	1,980	2,067
February	1.75	1.87	100	2,310	2,466	3,052	3,257
March	2.50	2.62	100	3,299	3,467	4,357	4,580
April	3.03	3.17	90	3,608	3,772	4,766	4,982
May	3.12	3.37	50	2,062	2,224	2,724	2,938
June	1.86	2.34	0	0	0	0	0
July	2.19	2.68	0	0	0	0	0
August	2.11	2.59	30	838	1,028	1,107	1,358
September	1.20	1.72	70	1,106	1,587	1,461	2,096
October	2.27	2.53	80	2,401	2,673	3,171	3,531
November	2.54	2.63	80	2,689	2,782	3,552	3,674
December	2.12	2.20	40	1,121	1,162	1,481	1,535
TOTAL	26.57	29.68		20,934	22,726	27,650	30,017

Rainfall Station = Naples.
Soil type = 0.4 in./ft.

Lee County

Vegetable Acreage. Table G-51 shows the historical vegetable acreage in Lee County by type. These data were assembled in the following manner:

- Historical acreage data for cucumbers, peppers, tomatoes, and watermelons were gathered from FASS Vegetable Summaries (FASS, Florida Dept. of Agriculture and Consumer Services, 1973-1974 to 1989-1990).

- Historical squash and potato acreage was assessed as a constant percentage of production in the "South" region of Florida (as reported by FASS), based on production data provided by the local IFAS extension office for the 1988-1989 growing season (University of Florida, 1989).

- A default value of 1,000 acres of latin vegetables was based on production reported by the local IFAS extension office for the 1988-89 growing season (University of Florida, 1989).

- A default value of 500 acres was entered for watermelon for the 6 year period period between 1977 and 1982. During this period FASS incorporated Lee County's watermelon acreage with several other counties and reported a total for the "South" region.

- With the exception of watermelon, potato, and latin vegetables, these acreages were divided by two (to reflect the two growing seasons), and summed to yield

the subtotal. FASS and IFAS report acreage as acres of production, i.e., 10 acres of row cultivated twice a year is reported as 20 acres.

- To yield the total land, fifteen percent was added to account for non-harvested acreage, and this number was divided by 0.6 to account for the land between rows.

TABLE G-51. Historical Vegetable Acreage in Lee County.

Year	Cucum-bers (D)	Peppers (D)	Squash* (D)	Tomatoes (D)	Double crop-ped/2 (row)	Potatoes** (S)	Latin Veg.*** (S)	Water-melon**** (S)	Sub-Total (row)	Total (row)	Total (land)
1989-90	1,650	1,600	900	1,350	2,750	455	1,000	900	5,105	5,871	9,785
1988-89	1,450	1,800	900	1,540	2,845	359	1,000	1,100	5,304	6,100	10,166
1987-88	1,650	1,700	977	1,480	2,903	287	1,000	800	4,991	5,739	9,565
1986-87	1,800	1,500	1,093	1,700	3,047	287	1,000	700	5,034	5,789	9,648
1985-86	2,000	1,350	1,279	1,670	3,150	287	1,000	800	5,237	6,022	10,037
1984-85	2,000	1,600	1,581	1,030	3,106	305	1,000	1,000	5,411	6,222	10,371
1983-84	1,600	1,650	1,488	650	2,694	269	1,000	600	4,563	5,248	8,747
1982-83	1,450	1,750	1,442	920	2,781	188	1,000	500	4,469	5,140	8,566
1981-82	1,450	1,900	1,395	1,210	2,978	278	1,000	500	4,756	5,469	9,115
1980-81	1,400	1,800	1,209	1,040	2,725	260	1,000	500	4,485	5,158	8,596
1979-80	1,350	1,950	1,163	1,790	3,126	215	1,000	500	4,842	5,568	9,280
1978-79	1,500	2,280	1,130	1,595	3,253	233	1,000	500	4,986	5,734	9,556
1977-78	1,500	2,230	1,079	1,145	2,977	215	1,000	500	4,692	5,396	8,994
1976-77	1,380	1,950	1,209	650	2,595	215	1,000	500	4,310	4,957	8,261
1975-76	1,550	1,850	953	485	2,419	215	1,000	450	4,085	4,697	7,829
1974-75	1,500	1,830	907	640	2,438	251	1,000	450	4,140	4,761	7,935
1973-74	1,580	1,650	674	600	2,252	278	1,000	600	4,130	4,750	7,917

(D) = Double cropped.
(S) = Single cropped.
* 1989 ratio (as reported by IFAS) applied to the FASS vegetable acreage total for the Southwest region for years before 1989 (47%).
** 1989 ratio (as reported by FASS) applied to the FASS vegetable acreage total for the Southwest region for all other years (350/2000).
*** Default value from IFAS.
**** Default value of 500 acres of watermelon for years 1977 through 1982.

Since acreage estimates for all vegetable crops were aggregated for projection purposes, there is no single price measure which accurately reflects the economic returns to vegetable production. Consequently time-trends and a dichotomous variable, designed to capture shifts in vegetable acreage were included in the projection model. The general formulation of the model is expressed in Equation (G-53).

$$A_t = f(t, D) \qquad \textbf{(G-53)}$$

where:
A_t = *acreage used for vegetable production in Lee County in year t.*
t = *a time-trend variable equal to 1 in 1974 and increasing by one unit each subsequent year.*

D = a 0-1 dichotomous variable equal to 0 before 1985 and equal to 1 in 1985 and after.

When Equation (G-53) was estimated using robust regression analysis, the results shown in Equation (G-54) were obtained.

$$A_t = \underset{(2.92)}{7958.171} + \underset{(2.15)}{85.220 * t} + 666.656 * D \qquad \text{(G-54)}$$

Goodness of fit statistics
$R^2 = .8387$
$F = 36.39$
$Pr F > 0 > .999$
$D - W = 1.149$
t - statistics in parentheses

The value of the Durbin-Watson (D-W) statistic is in the indeterminate region, which indicates a potential problem of serially correlated error terms. An evaluation of the model residuals shows that there was a tendency for the model to over-predict in the early years of the data set, 1974-1977. Alternative functional forms which reduced the problem of serially correlated error terms were examined; however, these alternative functional forms created new problems, so the decision was made to use Equation (G-54) as the primary projection model.

When Equation (G-54) was used to project Lee County vegetable acreage, and adjusted to reflect the difference between estimated and actual acreage for 1990, the results shown in Table G-52 were obtained. The primary projection is therefore column (G-55) minus 289 acres..

Vegetable Irrigation Requirements. The generalized cultivation schedule shown in Table G-53 was developed with the assistance of the local IFAS extension office.

For the calculation of irrigation requirements, data from the Fort Myers rainfall station on 0.8 inch soil were used. Table G-54 shows the supplemental water requirements and the estimated percentage of vegetable land in production in any given month (from Table G-53).

Historical and projected acreage of land used for vegetable production were taken from Table G-52. Vegetables are assumed to use seepage irrigation systems with an irrigation efficiency of 50 percent. Average and 2-in-10 irrigation requirements for the primary vegetable acreage projection for Lee County are presented in Table G-55.

TABLE G-52. Historical and Projected Acreage Used for Vegetable Production in Lee County.

Year	Historical	Column (G-54)	Primary projection	Primary -15%	Primary + 15%
1974	7,917				
1975	7,935				
1976	7,829				
1977	8,261				
1978	8,994				
1979	9,556				
1980	9,280				
1981	8,596				
1982	9,115				
1983	8,566				
1984	8,747				
1985	10,371				
1986	10,037				
1987	9,648				
1988	9,565				
1989	10,166				
1990	9,785	10,074			
Projections					
1991		10,159	9,870	8,390	11,351
1992		10,244	9,955	8,462	11,448
1993		10,329	10,040	8,534	11,546
1994		10,414	10,125	8,606	11,644
1995		10,500	10,211	8,679	11,743
1996		10,585	10,296	8,752	11,840
1997		10,670	10,381	8,824	11,938
1998		10,755	10,466	8,896	12,036
1999		10,841	10,552	8,969	12,135
2000		10,926	10,637	9,041	12,233
2001		11,011	10,722	9,114	12,330
2002		11,096	10,807	9,186	12,428
2003		11,181	10,892	9,258	12,526
2004		11,267	10,978	9,331	12,625
2005		11,352	11,063	9,404	12,722
2006		11,437	11,148	9,476	12,820
2007		11,522	11,233	9,548	12,918
2008		11,608	11,319	9,621	13,017
2009		11,693	11,404	9,693	13,115
2010		11,778	11,489	9,766	13,212

TABLE G-53. Generalized Cultivation Schedule for Vegetable Crops in Lee County.

Crop	Acres produced	Crops per year	Acres of land	Jan *	% tot land **	Feb *	% tot land **	Mar *	% tot land **	Apr *	% tot land **	May *	% tot land **
Tomatoes	2,000	2	1,000	50	9	100	17	100	17	100	17	50	9
Latin	1,000	1	1,000	100	17	100	17	100	17	100	17	100	17
Squash	2,000	2	1,000	50	9	100	17	100	17	100	17	50	9
Cucumbers	1,800	1	900	50	8	100	15	100	15	100	15	50	8
Potatoes	350	1	350	100	6	100	6	66	4	33	2	0	0
Watermelons	1,100	1	1,100	50	9	100	19	100	19	100	19	50	9
Peppers	1,000	2	900	50	4	100	9	100	9	100	9	50	4
TOTAL	9,250		5,850		62 ***	700	100 ***	666	98 ***	633	96 ***	350	56 ***

TABLE G-53. (Continued).

Crop	Jun *	% tot land **	Jul *	% tot land **	Aug *	% tot land **	Sep *	% tot land **	Oct *	% tot land **	Nov *	% tot land	Dec *	% tot land **
Tomatoes	0	0	0	0	50	9	100	17	100	17	100	17	50	9
Latin	100	17	100	17	100	17	100	17	100	17	100	17	100	17
Squash	0	0	0	0	50	9	100	17	100	17	100	17	50	9
Cucumbers	0	0	0	0	50	8	100	15	100	15	100	15	50	8
Potatoes	0	0	0	0	0	0	0	0	100	6	100	6	100	6
Watermelons	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peppers	0	0	0	0	50	4	100	9	100	9	100	9	50	4
TOTAL	100	17 ***	100	17 ***	300	46 ***	500	75 ***	600	81 ***	600	81 ***	400	52 ***

* Percentage of land dedicated to relevant crop which is actually in the ground in that total particular month.

** Land dedicated to relevant crop to vegetable production (percentage).

*** Weighted average percent of vegetable land acreage which is actually in production during the relevant month.

TABLE G-54. Supplemental Water Requirements for Vegetable Crops in Lee County.

Month	Average (in.)	2-in-10 (in.)	% in Ground
January	1.59	1.72	60
February	1.46	1.60	100
March	2.19	2.34	100
April	2.72	2.89	100
May	2.89	3.17	60
June	1.12	1.71	20
July	1.62	2.18	20
August	1.68	2.21	50
September	1.11	1.63	80
October	2.16	2.42	80
November	2.27	2.36	80
December	1.84	1.94	50
TOTAL	22.65	26.17	

Rainfall Station = Ft. Myers.
Soil Type = 0.8 inch.

TABLE G-55. Irrigation Requirements in Millions of Gallons for the Primary Vegetable Acreage Projection in Lee County.

Average	1985	1990	1995	2000	2005	2010
January	520	507	544	566	588	610
February	796	776	833	866	900	934
March	1,194	1,164	1,249	1,300	1,350	1,401
April	1,483	1,446	1,551	1,614	1,677	1,740
May	945	922	989	1,029	1,069	1,109
June	122	119	128	133	138	143
July	177	172	185	192	200	207
August	458	446	479	498	518	537
September	484	472	506	527	547	568
October	942	918	985	1,025	1,065	1,105
November	990	965	1,036	1,078	1,120	1,162
December	502	489	525	546	567	589
TOTAL	8,612	8,396	9,009	9,375	9,740	10,106

2-in-10	1985	1990	2005	2000	2005	2010
January	563	548	589	612	636	660
February	872	850	912	949	986	1,023
March	1,276	1,244	1,334	1,389	1,443	1,497
April	1,575	1,536	1,648	1,715	1,782	1,849
May	1,037	1,011	1,085	1,129	1,173	1,217
June	186	182	195	203	211	219
July	238	232	249	259	269	279
August	602	587	630	656	681	707
September	711	693	744	774	804	854
October	1,055	1,029	1,104	1,149	1,194	1,238
November	1,029	1,003	1,077	1,120	1,164	1,208
December	529	515	553	576	598	620
TOTAL	9,673	9,430	10,120	10,530	10,941	11,351

Hendry County Area

Vegetable Acreage. Table G-56 shows historical acreages used for vegetable production. These data were assembled in the following manner:

- Acreage data for cucumbers, peppers, tomatoes, and watermelons were gathered from FASS Vegetable Summaries (1966-67 and 1989-90). A default value for squash and eggplant was estimated by the local IFAS extension office.
- With the exception of watermelon, these acreages were divided by two (to reflect the two growing seasons), and summed to yield the subtotal. FASS reports acreage as acres of production (i.e., 10 acres of land cultivated twice a year is reported as 20 acres).
- To yield the total, fifteen percent was added to account for non-harvested acreage, and this number was divided by 0.6 to account for the land between rows.

TABLE G-56. Historical Vegetable Acreage in Hendry County.

Year	Cucumbers	Peppers	Tomatoes	Squash & Eggplant	Double crop/2 (row)	Water-melon	Subtotal (row)	Total (row)	Total (land)
1989-90	1,650	2,500	2,550	600	3,650	2,200	5,850	6,727	11,212
1988-89	1,600	3,000	3,270	600	4,235	2,500	6,735	7,745	12,909
1987-88	1,450	1,800	2,360	600	3,105	2,500	5,605	6,446	10,743
1986-87	1,800	1,700	1,700	600	2,900	2,500	5,400	6,210	10,350
1985-86	1,600	1,300	1,580	600	2,540	2,600	5,140	5,911	9,852
1984-85	1,200	1,200	1,370	600	2,185	2,800	4,985	5,733	9,555
1983-84	1,500	1,300	1,085	600	2,243	3,000	5,243	6,029	10,048
1982-83	1,600	1,600	1,530	600	2,665	3,100	5,765	6,630	11,050
1981-82	1,700	1,700	2,080	600	3,040	2,600	5,640	6,486	10,810
1980-81	1,650	1,760	2,530	600	3,270	2,500	5,770	6,635	11,059
1979-80	1,600	1,850	2,775	600	3,413	1,950	5,363	6,167	10,278
1978-79	1,750	2,200	2,580	600	3,565	1,500	5,065	5,825	9,708
1977-78	1,750	2,250	2,095	600	3,348	1,550	4,898	5,632	9,387
1976-77	1,850	2,200	1,030	600	2,840	1,900	4,740	5,451	9,085
1975-76	1,700	2,100	2,305	600	3,353	1,650	5,003	5,753	9,588
1974-75	1,500	1,670	2,255	600	3,013	2,050	5,063	5,822	9,703
1973-74	900	1,500	2,720	600	2,860	2,200	5,060	5,819	9,698
1972-73	900	1,580	4,110	600	3,595	2,450	6,045	6,952	11,586
1971-72	1,060	1,780	3,710	600	3,575	3,880	7,455	8,573	14,289
1970-71	1,240	1,930	4,420	600	4,095	3,600	7,695	8,849	14,749
1969-70	1,200	1,920	4,975	600	4,348	3,100	7,448	8,565	14,274
1968-69	1,290	1,200	4,720	600	3,905	3,500	7,405	8,516	14,193
1967-68	1,225	950	5,680	600	4,228	4,200	8,428	9,692	16,153
1966-67	950	800	5,810	600	4,080	3,800	7,880	9,062	15,103

Since acreage estimates for all vegetable crops were aggregated for projection purposes, there is no single price measure which accurately reflects the economic returns to vegetable production. Consequently time-trends and a dichotomous variable, designed to capture shifts in vegetable acreage were included in the projection model. The general formulation of the model is expressed in Equation (G-55).

$$LogA_t = f(t, D, logtime) \qquad \textbf{(G-55)}$$

where:
$LogA_t$ = *the common logarithm of vegetable acreage in Hendry County in year t.*
t = *a trend variable equal to 1 in 1966-67 and increasing by 1 each year.*
D = *a dichotomous variable equal to 0 prior to 1973-74 and 1 in 1973-74 and thereafter.*
logtime = the common logarithm of t.

Equation (G-56) represents the model estimated using ordinary least squares for total vegetable acreage.

$$LogA_t = 4.199 + .0090 * t - .1540 * logtime - .1515 * D \qquad \textbf{(G-56)}$$
$$(3.54) \qquad (-2.70) \qquad (-5.60)$$

Goodness of fit statistics
$R^2 = .8443$
$F = 36.15$
$Pr\, F > 0 > .999$
t - statistics in parentheses
$D\text{-}W = 1.683$

Projections derived from Equation (G-56) are shown in column (G-56) in Table G-57. These projections were adjusted by the amount by which vegetable acreage was over projected in 1990, and amounted to subtracting 84 acres from column (G-56) to yield the primary projection.

Vegetable Irrigation Requirements. The generalized cultivation schedule shown in Table G-58 was developed with the assistance of the local IFAS extension office.

Table G-59 represents the supplemental water requirements and the estimated percent of vegetable land in production in any given month (from Table G-58). Soil with a usable water capacity of 0.8 inch was chosen as representative of land most used for vegetable production in Hendry County.

The primary acreage projection was used to calculate the irrigation requirements shown in Table G-60.

TABLE G-57. Historical and Projected Acreage Used for Vegetable Production in Hendry County.

Year	Historical	Column (G-56)	Primary Projection	Primary -15%	Primary +15%
1967	15,103				
1968	16,153				
1969	14,193				
1970	14,274				
1971	14,749				
1972	14,289				
1973	11,586				
1974	9,698				
1975	9,703				
1976	9,588				
1977	9,085				
1978	9,387				
1979	9,708				
1980	10,278				
1981	11,059				
1982	10,810				
1983	11,050				
1984	10,048				
1985	9,555				
1986	9,852				
1987	10,350				
1988	10,743				
1989	12,909				
1990	11,212	11,296			
Projections					
1991		11,461	11,377	9,671	13,084
1992		11,632	11,548	9,816	13,281
1993		11,808	11,724	9,966	13,483
1994		11,990	11,906	10,121	13,692
1995		12,176	12,092	10,279	13,906
1996		12,368	12,284	10,442	14,127
1997		12,564	12,480	10,608	14,353
1998		12,766	12,682	10,780	14,585
1999		12,974	12,890	10,957	14,824
2000		13,186	13,102	11,137	15,068
2001		13,404	13,320	11,322	15,319
2002		13,627	13,543	11,512	15,575
2003		13,855	13,771	11,706	15,837
2004		14,089	14,005	11,905	16,106
2005		14,328	14,244	12,108	16,381
2006		14,572	14,488	12,315	16,662
2007		14,823	14,739	12,529	16,950
2008		15,079	14,995	12,746	17,245
2009		15,341	15,257	12,969	17,546
2010		15,608	15,524	13,196	17,853

TABLE G-58. Generalized Cultivation Schedule for Vegetable Crops in Hendry County.

Crop	Acres produced	Crops per year	Acres of land	Jan *	% tot land **	Feb *	% tot land **	Mar *	% tot land **	Apr *	% tot land **	May *	% tot land **
Tomatoes	2,360	2	1,180	50	11	100	21	100	21	100	21	50	11
Cucumbers	1,450	2	725	50	6	100	13	100	13	100	13	50	6
Squash	600	2	300	50	3	100	5	100	5	100	5	50	3
Peppers	1,800	2	900	50	8	100	16	100	16	100	16	50	8
Watermelons	2,500	1	2,500	50	22	100	45	100	45	100	45	50	22
TOTAL	8,710		5,605		50 ***		100 ***		100 ***		100 ***		50 ***

TABLE G-58. (Continued).

Crop	Jun *	% tot land **	Jul *	% tot land **	Aug *	% tot land **	Sep *	% tot land **	Oct *	% tot land **	Nov *	% tot land	Dec *	% tot land **
Tomatoes	0	0	0	0	50	11	100	21	100	21	100	21	50	11
Cucumbers	0	0	0	0	50	6	100	13	100	13	100	13	50	6
Squash	0	0	0	0	50	3	100	5	100	5	100	5	50	3
Peppers	0	0	0	0	50	8	100	16	100	16	100	16	50	8
Watermelons	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		0 ***		0 ***		28 ***		55 ***		55 ***		55 ***		28.

* Percentage of land dedicated to relevant crop which is actually in the ground in that total particular month.

** Land dedicated to relevant crop to vegetable production (percentage).

*** Weighted average percent of vegetable land acreage which is actually in production during the relevant month.

TABLE G-59. Supplemental Water Requirements for Vegetable Crops in Hendry County.

Month	Average (in.)	2-in-10 (in.)	Approx. % in ground
January	1.67	1.78	50
February	1.39	1.54	100
March	1.95	2.14	100
April	2.43	2.64	100
May	2.75	3.04	50
June	1.09	1.67	0
July	1.67	2.22	0
August	1.80	2.30	30
September	1.23	1.72	60
October	2.09	2.35	60
November	2.24	2.33	60
December	1.80	1.89	30
TOTAL	22.11	25.61	

Rainfall station = La Belle.
Soil type = 0.8 inch.

TABLE G-60. Irrigation Requirements in Millions of Gallons for the Primary Vegetable Acreage Projections in the Hendry County Area.

Average	1985	1990	1995	2000	2005	2010
January	191	224	219	212	203	191
February	317	372	365	353	338	318
March	446	523	513	496	475	447
April	555	652	639	618	592	557
May	314	369	362	350	335	315
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	123	144	142	137	131	123
September	169	198	194	188	179	169
October	286	336	329	318	305	287
November	307	361	354	342	327	308
December	123	144	142	137	131	123
TOTAL	2,831	3,322	3,260	3,153	3,015	2,838

2-in-10	1985	1990	1995	2000	2005	2010
January	203	238	234	226	216	203
February	351	412	404	391	374	352
March	488	573	562	543	520	489
April	602	707	693	671	641	604
May	347	408	400	387	370	348
June	0	0	0	0	0	0
July	0	0	0	0	0	0
August	157	185	181	175	168	158
September	236	277	272	263	251	237
October	322	377	370	358	343	322
November	320	375	368	356	340	320
December	130	152	149	144	138	130
TOTAL	3,156	3,703	3,633	3,514	3,361	3,163

Irrigated Acreage	1985	1990	1995	2000	2005	2010
County	9,555	11,212	12,176	13,186	14,328	15,608
County Area	4,204	4,933	4,840	4,681	4,478	4,214
% in LWC	44%	44%	39.75%	35.5%	31.25%	27%

Glades County Area

Vegetable Acreage. Glades County vegetable production is included in the "West Central" area as defined by the FASS Vegetable Summaries, and acreage data for Glades County individually is not available from FASS. The only vegetable acreage data available was that supplied by the local IFAS extension agent, and only for 1989. Due to the lack of historical data, future vegetable acreage was projected at its current level (±15 percent). Present vegetable production is very modest in Glades County (approximately 100 acres), and is projected to remain constant by the local extension office.

Vegetable Irrigation Requirement. All vegetable production in Glades County takes places in the LWC Planning Area. Vegetable crops grown in the Glades County Area are usually cultivated twice a year between August and May with the planting and harvesting schedule shown in Table G-61.

TABLE G-61. Average Planting and Harvesting Schedule for Vegetables in the Glades County Area.

Fall			
August	September	November	December
1/2 planted	1/2 planted	1/2 harvested	1/2 harvested
Winter			
January	February	April	May
1/2 planted	1/2 planted	1/2 harvested	1/2 harvested

Source: IFAS Extension Office, Moore Haven, Florida.

Table G-62 represents the supplemental water requirements for vegetable crops using the planting dates outlined in Table G-61. In Glades County, vegetable production takes place on muck soil with an estimated usable water capacity of 3.6 inches.

The primary acreage projection was used to calculate the irrigation requirements shown in Table G-63.

TABLE G-62. Supplemental Water Requirements for Vegetable Crops in Glades County.

Month	January Planting		February Planting		August Planting		September Planting	
	Avg. (in.)	2-in-10 (in.)	Avg. (in.)	2-in-10 (in.)	Avg. (in.)	2-in-10 (in)	Avg. (in.)	2-in-10 (in)
January	0.76	0.91						
February	1.52	1.72	0.54	0.72				
March	2.26	2.51	2.07	2.32				
April	1.37	1.66	2.63	2.94				
May			1.01	1.47				
June								
July								
August					0.00	0.29		
September					0.46	1.22	0.00	0.00
October					1.96	2.41	1.75	2.19
November					1.55	1.70	2.57	2.72
December							1.32	1.44
TOTAL	5.91	6.80	6.25	7.45	3.97	5.62	5.64	6.35

Rainfall Station = Moore Haven.
Soil type = 3.6 inches.

TABLE G-63. Irrigation Requirements for the Primary Vegetable Acreage Projection in the Glades County Area.

Month	Average (MG)	2-in-10 (MG)
January	2	2
February	6	7
March	12	13
April	11	12
May	3	4
June	0	0
July	0	0
August	0	1
September	1	3
October	10	12
November	11	12
December	4	4
TOTAL	60	70

Charlotte County Area

Vegetable Acreage. Charlotte County's historical vegetable acreage is combined with other counties' data when published in the FASS Vegetable Summaries. Because of this consolidation, data from the Vegetable Summaries were not suitable to establish crop acreages or production trends.

An agricultural commodity report developed by the local Soil Conservation Office at the request of the District (Table G-64) reported the land used for vegetable production in the Charlotte County Area for the most recent year of production (1991).

TABLE G-64. Vegetable Production in Charlotte County Area, 1991.

Crop	Acres of Production	Spring Acreage	Fall Acreage
Tomatoes	1,814	1,014	800
Potatoes	150	150	0
Snap Beans	100	100	0
Peppers	1,600	800	800
Watermelon	242	242	0
TOTAL	3,906	2,306	1,600

Source: Steve Pirie, Soil Conservation Service, 4/9/92.

No meaningful trend or explanatory mathematical model could be developed due to the lack of historical vegetable acreage data in the Charlotte County Area. Therefore, irrigated vegetable acreage was projected to remain constant ($\pm$15 percent). The projection of a constant vegetable acreage in the Charlotte County Area is consistent with empirical input from the local Soil Conservation Service office, and the vegetable acreage projections developed for neighboring Hendry and Lee counties, where there were enough data to establish trends.

Vegetable Irrigation Requirements. Table G-65 was applied to the supplemental water requirements for vegetables in the area to calculate irrigation requirements. Supplemental water requirements and irrigation requirements for vegetables in the Charlotte County Area are presented in Table G-66.

TABLE G-65. Generalized Cultivation Schedule for Vegetable Crops in Charlotte County.

Crop	Acres produced	Crops per year	Acres of land	Jan *	% tot land **	Feb *	% tot land **	Mar *	% tot land **	Apr *	% tot land **	May *	% tot land **
Tomatoes	1,814	2	1,014	50	22	100	44	100	44	100	44	50	22
Snap Beans	100	1	100	50	2	100	4	100	4	100	4	50	2
Peppers	1,600	2	800	50	17	100	35	100	35	100	35	50	17
Potatoes	150	1	150	100	7	100	7	66	4	33	2	0	0
Watermelons	242	1	242	50	5	100	10	100	10	100	10	50	5
Total	3,906		2,306		53 ***		100 ***		98 ***		47 ***		0 ***

TABLE G-65. (Continued).

Crop	Jun *	% tot land **	Jul *	% tot land **	Aug *	% tot land **	Sep *	% tot land **	Oct *	% tot land **	Nov *	% tot land	Dec *	% tot land **
Tomatoes	0	0	0	800	50	17	100	35	100	35	100	35	50	17
Snap Beans	0	0	0	0	50	0	100	0	100	0	100	0	50	0
Peppers	0	0	0	800	50	17	100	35	100	35	100	35	50	17
Potatoes	0	0	0	0	0	0	0	0	100	0	100	0	100	0
Watermelons	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0 ***		1,600 ***		35 ***		69 ***		69 ***		69 ***		35

* Percentage of land dedicated to relevant crop which is actually in the ground in that total particular month.

** Land dedicated to relevant crop/ total land dedicated to vegetable crop production (percentage).

*** Weighted average percent of vegetable land acreage which is actually in production during the relevant month.

TABLE G-66. Supplemental Water Requirements and Irrigation Requirements for Vegetable Crops in the Charlotte County Area.

Month	Supplemental Water Requirements		Approx % in ground	Irrigation Requirements	
	Average (in.)	2-in-10 (in)		Average (MG)	2-in-10 (MG)
January	1.67	1.78	50	105	111
February	1.39	1.54	100	174	193
March	1.95	2.14	100	245	268
April	2.43	2.64	100	305	330
May	2.75	3.04	50	172	191
June	1.09	1.67	0	0	0
July	1.67	2.22	0	0	0
August	1.80	2.30	40	90	115
September	1.23	1.72	70	108	151
October	2.09	2.35	70	183	206
November	2.24	2.33	70	197	204
December	1.80	1.89	40	90	95
TOTAL	22.11	25.61		1,668	1,864

Rainfall station = La Belle.
Soil type = 0.8 inch.

Field Crops

Field crop production in the LWC Planning Area is limited to the Charlotte County Area. This acreage varies from year to year based on the demand for seed corn, which in turn is primarily dependent on production in other parts of the country. This variation in production of more of a fluctuation than a trend.

An agricultural commodity report developed by the local Soil Conservation Service office at the request of the District (Table G-67) reported the land used for filed crop production in the Charlotte County Area for the most recent years of production (1991).

TABLE G-67. Field Crop Production in the Charlotte County Area, 1991.

Crop	Acres of Production	Spring Acreage	Fall Acreage
Seed Corn	2,123	1,423	700
Soybeans	1,000	1,000	0
TOTAL	3,123	2,423	700

Source: Steve Pirie, Soil Conservation Service, April 9, 1992.

While fluctuations are anticipated, the magnitude of the acreages presented are typical for the Charlotte County Area. Irrigation requirements were calculated based on these acreages with the cultivation schedule Table G-68, data from the La Belle rainfall station, and seepage systems with an estimated irrigation efficiency of 50 percent. Irrigation requirements are presented in Table G-68.

TABLE G-68. Irrigation Requirements for Field Crops in the Charlotte County Area.

Month	Seed Corn			Soybean			Total	
	Avg. (in.)	2-in-10 (in.)	Approx. Acreage in Ground	Avg. (in.)	2-in-10 (in.)	Approx. Acreage in Ground	Avg. (MG)	2-in-10 (MG)
January	3.10	3.22	700	0.00	0.00	0	118	122
February	2.49	2.65	1,062	0.00	0.13	500	144	156
March	1.22	1.40	1,423	0.63	0.80	1,000	129	152
April	2.37	2.58	1,423	1.88	2.08	1,000	285	312
May	4.43	4.75	1,423	3.87	4.18	1,000	553	594
June	3.56	4.26	1,423	3.21	3.89	1,000	449	541
July	4.26	4.92	712	2.92	3.51	500	244	285
August	3.82	4.39	0	0.00	0.00	0	0	0
September	0.31	0.77	350	0.00	0.00	0	6	15
October	2.03	2.29	700	0.00	0.00	0	77	87
Novemeber	3.34	3.44	700	0.00	0.00	0	127	131
Decemeber	3.29	3.39	700	0.00	0.00	0	125	129
TOTAL	34.22	38.06		12.51	14.59		2,256	2,524

Rainfall station = La Belle.
Soil type = 0.8 inch.

Sod

There is some variation in the production practices of sod in the LWC Planning Area. Some harvested sod is irrigated, and some is not, serving largely as pasture until the sod is sold. Since the objective here is to project irrigation requirement, only irrigated sod is addressed.

Lee County

Sod Acreage. There were 650 acres of irrigated sod in Lee County in 1989 (IFAS, University of Florida, 1989). No meaningful trend or explanatory mathematical model could be developed due to the lack of historical sod acreage data in Lee County. Similarly, no convincing empirical knowledge of future changes in sod acreage was available from the local IFAS extension office. Therefore, irrigated sod acreage was projected to remain relatively constant through the year 2010 ($\pm$15 percent) at 650 acres, and the primary range is from 553 to 748 acres.

Sod Irrigation Requirement. The irrigation requirements in Table G-69 were calculated by applying the current irrigated acreage to the District's modified

Blaney-Criddle permitting model. Input variables used were 650 acres of grass, sandy soil with 0.8 inch usable soil water capacity, seepage systems with an irrigation efficiency of 50 percent, with Fort Myers as the rainfall station.

TABLE G-69. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in Lee County.

Month	Supplemental Water Requirements		Irrigation Requirements	
	Average (in.)	2-in-10 (in.)	Average (MG)	2-in-10 (MG)
January	1.00	1.12	35	40
February	1.16	1.30	41	46
March	2.55	2.70	90	95
April	3.81	4.00	135	141
May	4.51	4.82	159	170
June	2.75	3.41	97	120
July	3.37	4.01	119	42
August	3.35	3.94	118	139
September	2.36	2.93	83	103
October	2.91	3.18	103	112
November	2.33	2.43	82	86
December	1.44	1.54	51	54
TOTAL	31.54	35.38	1,113	1,249

Rainfall Station = Ft. Myers.
Soil Type = 0.8 inch.

Hendry County Area

Sod Acreage. Currently, there are two companies producing irrigated sod in Hendry County. According to District water use permits, these two companies use a total of 2,945 acres. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical sod acreage data in Hendry County. Therefore, irrigated sod acreage was projected to remain constant through the year 2010 (±15 percent). The primary projection for the six time horizons is 2,945 acres, and the primary range is from 2,503 to 3,387 acres.

Sod Irrigation Requirement. All commercial sod production in Hendry County is in the LWC Planning Area. Input variables used to calculate the irrigation requirements of sod in the Hendry County Area were 2,945 acres of grass, sandy soil with 0.8 inch usable soil water capacity, seepage irrigation systems with an irrigation efficiency of 50 percent, with La Belle as the rainfall station. These irrigation requirements are shown in Table G-70.

TABLE G-70. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in the Hendry County Area.

Month	Supplemental Water Requirements		Irrigation Requirements	
	Average (in.)	2-in-10 (in.)	Average (MG)	2-in-10 (MG)
January	1.08	1.18	173	189
February	1.09	1.24	174	198
March	2.30	2.49	368	398
April	3.50	3.72	560	595
May	4.35	4.67	696	747
June	2.70	3.35	432	536
July	3.42	4.03	547	645
August	3.46	4.02	553	643
September	2.48	3.02	397	483
October	2.82	3.09	451	494
November	2.31	2.40	369	384
December	1.42	1.51	227	242
TOTAL	30.93	34.72	4,947	5,553

Rainfall Station = La Belle.
Soil Type = 0.8 inch.

Glades County Area

Sod Acreage. There is only one company presently producing irrigated sod in Glades County, using 673 acres. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical sod acreage data in Glades County. Therefore, irrigated sod acreage was projected to remain constant through the year 2010 (±15 percent). The primary projection for the six time horizons is 673 acres, and the primary range is from 572 to 774 acres.

Sod Irrigation Requirements. All commercial sod production in Glades County is in the LWC Planning Area. The irrigation requirements in Table G-71 were calculated by applying the current irrigated acreage to the Blaney-Criddle permitting model. Input variables used were 673 acres of grass, sandy soil with 0.8 inch usable soil water capacity, seepage irrigation systems with an irrigation efficiency of 50 percent, with Moore Haven as the rainfall station.

TABLE G-71. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in the Glades County Area.

Month	Supplemental Water Requirements		Irrigation Requirements	
	Average (in.)	2-in-10 (in.)	Average (MG)	2-in-10 (MG)
January	1.09	1.20	40	44
February	1.21	1.34	44	49
March	2.39	2.57	87	94
April	3.45	3.67	126	134
May	3.98	4.35	145	159
June	3.05	3.68	111	135
July	3.62	4.24	132	155
August	3.73	4.29	136	157
September	2.50	3.06	91	112
October	2.71	3.03	99	111
November	2.27	2.38	83	87
December	1.50	1.59	55	58
TOTAL	31.5	35.4	1,149	1,295

Rainfall Station = Moore Haven.
Soil type = 0.8 inch.

Ornamental Nursery

The majority of ornamental nurseries in the LWC Planning Area use overhead sprinkler systems for irrigation. Normally overhead sprinkler irrigation systems are estimated by the District to have an irrigation efficiency of 75 percent. However, an indeterminable number of nurseries containerize their plants, and this reduces the system efficiency to approximately 20 percent. To account for this range of efficiencies, an average efficiency of 50 percent was assumed. Micro irrigation systems will be required on all new container nursery projects, raising the estimated efficiency of these projects to 85 percent, and the future overall average efficiency to 80 percent. This often means that, even with increased acreage, the overall ornamental nursery irrigation demands are reduced (SFWMD, 1985, rev. 1993). Currently the District's Blaney-Criddle permitting model has no category for ornamental nursery, and the value for grass is used for permitting purposes.

Collier County

Ornamental Nursery Acreage. Collier County ornamental nursery acreage is expanding. However, due to the inconsistent nature of historical acreage data, no meaningful trend or explanatory mathematical model could be developed. The local IFAS extension office estimates that a reasonable projected growth rate for the next five years is 30 acres per year.

If this rate is applied throughout the projection period, it leads to estimates of 1,532 acres in 1995, 1,682 acres in 2000, 1,832 acres in 2005, and 1,982 acres in 2010. Historical ornamental nursery acreage is shown in Table G-72.

TABLE G-72. Historical Ornamental Nursery Acreage in Collier County.

Year	Historical	Year	Historical
1972	416	1982	328
1973	600	1983	328
1974	336	1984	260
1975	1,035	1985	227
1976	360	1986	226
1977	496	1987	528
1978	unavailable	1988	578
1979	329	1989	946
1980	286	1990	1,382
1981	291		

Source: Bureau of Plant Inspection, Annual Reports 1972-1990, Division of Plant Industry, Florida Dept. of Agr. and Consumer Services.

Ornamental Nursery Irrigation Requirements. Supplemental water requirements for grass at the Naples rainfall station on 0.4 inch soil are shown in Table G-73. These water requirements were applied to the ornamental nursery acreage projections to calculate the irrigation requirements shown in Table G-74.

TABLE G-73. Supplemental Water Requirements for Grass in Collier County.

Month	Average (in.)	2-in-10 (in.)
January	1.23	1.33
February	1.43	1.55
March	2.87	3.00
April	4.17	4.31
May	4.76	5.03
June	3.58	4.13
July	4.02	4.58
August	3.84	4.38
September	2.47	3.04
October	3.04	3.31
November	2.62	2.70
December	1.71	1.78
TOTAL	35.74	39.14

Rainfall Station = Naples.
Soil type = 0.4 inch.

TABLE G-74. Irrigation Requirements in Millions of Gallons for the Primary Ornamental Nursery Acreage Projections in Collier County.

Average	1985	1990	1995	2000	2005	2010
January	15	92	64	70	76	83
February	18	107	74	82	89	96
March	35	215	149	164	178	193
April	51	313	217	238	259	281
May	59	357	248	272	296	320
June	44	269	186	204	223	241
July	50	302	209	230	250	270
August	47	288	200	219	239	258
September	30	185	128	141	154	166
October	37	228	158	174	189	205
November	32	197	136	150	163	176
December	21	128	89	98	106	115
TOTAL	441	2,683	1,859	2,041	2,223	2,405
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	16	100	69	76	83	89
February	19	116	81	88	96	104
March	37	225	156	171	187	202
April	53	324	224	246	268	290
May	62	378	262	287	313	338
June	51	310	215	236	257	278
July	56	344	238	261	285	308
August	54	329	228	250	272	295
September	37	228	158	174	189	205
October	41	248	172	189	206	223
November	33	203	140	154	168	182
December	22	134	93	102	111	120
TOTAL	483	2,938	2,035	2,235	2,434	2,633

Lee County

Ornamental Nursery Acreage. In order to project Lee County ornamental nursery acreage, a model of the form shown in Equation (G-57) was estimated.

$$LEEORN_t = f(Year, D) \quad \text{(G-57)}$$

where:
$LEEORN_t$ = *Lee County ornamental nursery acreage in year t.*
Year = the numeric value of the year for which ornamental nursery acreage is being projected (e. g., the value of Year for 1988 is 1988).
D = 1 in 1987, 0 otherwise.

The D variable was included to take into account a large one-time increase in acreage from 398 in 1986 to 625 in 1987. It is hypothesized that this one-time increase in ornamental nursery acreage may have been associated with replacement of plants damaged by the freezes in the mid-1980s. When Equation (G-57) was estimated using ordinary least squares, the results obtained in Equation (G-58) were obtained.

$$LEEORN_t = -37534.03 + \underset{(9.18)}{19.133} * Year + \underset{(2.79)}{141.944} * D \quad \text{(G-58)}$$

Goodness of fit statistics
$R^2 = .8621$
$F = 56.12$
$Pr F > 0 > .999$
$D - W = 2.398$
t-statistics in parentheses

Equation (G-58), adjusted for the amount by which it under projected 1990 acreage (66 acres), was used to generate the primary projection for Lee County ornamental nursery acreage. The resulting projections are shown in Table G-75.

Ornamental Nursery Irrigation Requirements. Supplemental water requirements for grass on 0.8 inch soil in Lee County are shown in Table G-69. These water requirements were applied to the ornamental nursery acreage projections (shown in Table G-75) to calculate the irrigation requirements (shown in Table G-76).

TABLE G-75. Historical and Projected Ornamental Nursery Acreage in Lee County.

Year	Historical	Primary Projection	Primary -15 %	Primary +15 %
1972	251			
1973	264			
1974	158			
1975	285			
1976	232			
1977	267			
1978	unavailable			
1979	251			
1980	370			
1981	406			
1982	437			
1983	413			
1984	430			
1985	441			
1986	398			
1987	625			
1988	486			
1989	508			
1990	606	540		
Projections				
1991		625	531	719
1992		644	547	741
1993		663	564	762
1994		683	581	785
1995		702	597	807
1996		721	613	829
1997		740	629	851
1998		759	645	873
1999		778	661	895
2000		797	677	917
2001		816	694	938
2002		836	711	961
2003		855	727	983
2004		874	743	1,005
2005		893	759	1,027
2006		912	75	1,049
2007		931	791	1,071
2008		950	808	1,093
2009		970	825	1,116
2010		989	841	1,137

Source: Historical acreage from Bureau of Plant Inspection Annual Reports, 1972-1990, Division of Plant Industry, Florida Dept. of Agr. and Consumer Services.

TABLE G-76. Irrigation Requirements in Millions of Gallons for the Primary Ornamental Nursery Acreage Projections in Lee County.

Average	1985	1990	1995	2000	2005	2010
January	24	33	24	27	30	34
February	28	38	28	31	35	39
March	61	84	61	69	77	86
April	91	125	91	103	115	128
May	108	148	107	122	137	151
June	66	91	66	74	83	92
July	81	111	80	91	102	113
August	80	110	80	91	102	112
September	57	78	56	64	72	79
October	70	96	69	79	88	98
November	56	77	56	63	71	78
December	34	47	34	39	44	48
TOTAL	755	1,038	752	853	956	1,059

2-in-10	1985	1990	1995	2000	2005	2010
January	27	37	27	30	34	38
February	31	43	31	35	39	44
March	65	89	64	73	82	91
April	96	132	95	108	121	134
May	115	159	115	130	146	162
June	82	112	81	92	103	114
July	96	132	96	108	122	135
August	94	130	94	107	119	132
September	70	96	70	79	89	98
October	76	105	76	86	96	107
November	58	80	58	66	74	82
December	37	51	37	42	47	52
TOTAL	847	1,164	843	957	1,072	1,188

Hendry County Area

Ornamental Nursery Acreage. An equation of the form (G-59) was used to project ornamental nursery acreage for Hendry County.

$$HENORN_i = f(t, D_t) \quad \textbf{(G-59)}$$

where:
$HENORN_i$ = *ornamental nursery acreage in Hendry County in year i.*
t = *a trend variable which takes on a value of 5 in 1976 and increased by one unit per year throughout the estimation period (1976-1990).*
D_t = *a dichotomous variable which takes on a value of 0 prior to 1990 and a value of 1 in 1990. For projection purposes the value of D_t is held at 1 throughout the period to be projected.*

When model (G-59) was estimated using ordinary least squares, Equation (G-60) resulted:

$$HENORN_i = -20.239 + 23.550 * t + 596.978 * D_t \quad \textbf{(G-60)}$$
$$(4.60) \qquad (7.07)$$

Goodness of fit statistics
$R^2 = .9175$
$F = 61.17$
$Pr\ F > 0 > .999$
t - statistics in parentheses
$D\text{-}W = 2.006$

The negative coefficient on the intercept term may be interpreted as the predicted value of $HENORN_i$ when t and D_t are 0. Since acreage by definition is non-negative, this suggests that there may be some non-linearity in the trend. It should be noted that the t-statistic on the intercept is -0.45, which is not statistically significant at the 10 percent level of significance. However, when non-linear models were tested, the projections tended to grow to what were considered to be improbable levels within the projection period. In addition, several linear and non-linear models which omitted the 1990 dichotomous variable tended to severely underestimate 1990 acreage. In interpreting projections made with Equation (G-60), it should be noted that the future course of ornamental nursery acreage in Hendry County depends upon the nature of the change which occurred between 1989 and 1990. As additional data for 1991 and future years become available, the appropriate formulation of the model should become clearer.

Ornamental Nursery Irrigation Requirements. Supplemental water requirements for grass on 0.8 inch soil in Hendry County are shown in Table G-70. These water requirements were applied to the ornamental nursery acreage projections (shown in Table G-77) to calculate the irrigation requirements (shown in Table G-78). All the ornamental nursery acreage in Hendry County is in the LWC Planning Area.

TABLE G-77. Historical and Projected Ornamental Nursery Acreage in Hendry County.

Year	Historical	Primary Projection	Primary -15 %	Primary+15 %
1976	49			
1977	59			
1978	unavailable			
1979	67			
1980	77			
1981	126			
1982	150			
1998	110			
1984	164			
1985	124			
1986	200			
1987	245			
1988	487			
1989	281			
1990	930			
Projections				
1991		954	811	1,097
1992		977	830	1,124
1993		1,001	851	1,151
1994		1,024	870	1,178
1995		1,048	891	1,205
1996		1,071	910	1,232
1997		1,095	931	1,259
1998		1,118	950	1,286
1999		1,142	971	1,313
2000		1,166	991	1,341
2001		1,189	1,011	1,367
2002		1,213	1,031	1,395
2003		1,236	1,051	1,421
2004		1,260	1,071	1,449
2005		1,283	1,091	1,475
2006		1,307	1,111	1,503
2007		1,330	1,131	1,529
2008		1,354	1,151	1,557
2009		1,377	1,170	1,584
2010		1,401	1,191	1,611

Source: Historical acreage from Bureau of Plant Inspection Annual Reports, 1976-1990, Division of Plant Industry, Florida Dept. of Agr. and Consumer Services.

TABLE G-78. Irrigation Requirements in Millions of Gallons for the Primary Ornamental Nursery Acreage Projection in the Hendry County Area.

Average	1985	1990	1995	2000	2005	2010
January	7	55	59	63	67	72
February	7	55	59	64	68	72
March	15	116	125	135	144	153
April	24	177	191	205	219	233
May	29	220	237	255	272	289
June	18	136	147	158	169	180
July	23	173	186	200	214	227
August	23	175	189	202	216	230
September	17	125	135	145	155	165
October	19	142	154	165	176	188
November	16	117	126	135	144	154
December	10	72	77	83	89	94
TOTAL	208	1,562	1,686	1,810	1,933	2,057

2-in-10	1985	1990	1995	2000	2005	2010
January	8	60	64	69	74	78
February	8	63	68	73	77	82
March	17	126	136	146	156	166
April	25	188	203	218	232	247
May	31	236	255	273	292	311
June	23	169	183	196	209	223
July	27	204	220	236	252	268
August	27	203	219	235	251	267
September	20	153	165	177	189	201
October	21	156	168	181	193	205
November	16	121	131	140	150	160
December	10	76	82	88	94	100
TOTAL	234	1,754	1,893	2,032	2,170	2,309

Glades County Area

Ornamental Nursery Acreage. In order to forecast ornamental nursery acreage for Glades County, a model was developed using data for the period 1976-1990. The functional form of this model is outlined in Equation (G-61).

$$GLAORN_i = f(t, D_i) \qquad \text{(G-61)}$$

where:
$GLAORN_i$ = *acreage of Glades ornamental nursery in year i.*
t = *a trend variable which takes on a value of 5 in 1976 and increases by 1 unit each year.*
D_i = *a dichotomous variable where* $D_i = 0$ *prior to 1986 and 1 in 1986 and following years.*

The model was estimated using robust regression and is shown in Equation (G-62), which was used to generate the primary projection for Glades County ornamental nursery acreage. A minute adjustment was made for the amount by which the model over projected acreage for 1990 (one acre was subtracted from projections), and the resulting projections are shown in Table G-79).

$$Glncn_i = -15.67821 + 9.030 * t + 469.479 * D_i \qquad \text{(G-62)}$$
$$(10.90) \qquad (68.39)$$

Goodness of fit statistics
$R^2 = .9997$
$F = 10616$
$Pr\,F > 0 > .9999$
t - statistics in parentheses
$D\text{-}W = 2.348$

TABLE G-79. Historical and Projected Ornamental Nursery Acreage in Glades County.

Year	Historical	Primary Projection	Primary -15 %	Primary +15 %
1976	21			
1977	42			
1978	unavailable			
1979	4			
1980	68			
1981	83			
1982	83			
1983	68			
1984	103			
1985	109			
1986	164			
1987	528			
1988	607			
1989	409			
1990	502	503		
Projections				
1991		511	434	588
1992		521	443	599
1993		530	451	610
1994		539	458	620
1995		548	466	630
1996		558	474	642
1997		567	482	652
1998		576	490	662
1999		586	498	674
2000		595	506	684
2001		604	513	695
2002		614	522	706
2003		623	530	716
2004		632	537	727
2005		641	545	737
2006		651	553	749
2007		660	561	759
2008		669	569	769
2009		679	577	781
2010		688	585	791

Source: Historical acreage from Bureau of Plant Inspection Annual Reports, 1976-1990, Division of Plant Industry, Florida Dept. of Agr. and Consumer Services.

Ornamental Nursery Irrigation Requirements. Supplemental water requirements for grass on 0.8 inch soil in Glades County are shown in Table G-71. These water requirements were applied to the ornamental nursery acreage projections (shown in Table G-79) to calculate the irrigation requirements (shown in Table G-80). All the ornamental nursery acreage is in the LWC Planning Area.

TABLE G-80. Irrigation Requirements in Millions of Gallons for the Primary Ornamental Nursery Acreage Projection in the Glades County Area.

Average	1985	1990	1995	2000	2005	2010
January	6	30	31	33	35	37
February	7	33	35	37	39	41
March	14	65	69	73	76	80
April	20	94	99	105	110	116
May	24	109	115	121	127	134
June	18	83	88	93	98	102
July	21	99	104	110	116	122
August	22	102	108	113	119	125
September	15	68	72	76	80	84
October	16	74	78	82	87	91
November	13	62	65	69	73	76
December	9	41	43	46	48	50
TOTAL	186	859	908	958	1,007	1,058

2-in-10	1985	1990	1995	2000	2005	2010
January	7	33	33	37	38	40
February	8	37	39	41	43	45
March	15	70	74	78	82	86
April	22	100	106	112	117	123
May	26	119	125	132	139	146
June	22	100	106	112	118	124
July	25	116	122	129	136	142
August	25	117	124	131	137	144
September	18	83	88	93	98	103
October	18	83	87	92	97	102
November	14	65	69	72	76	80
December	9	43	46	48	51	53
TOTAL	210	965	1,020	1,077	1,132	1,189

Improved Pasture/Cattle Watering

Improved pasture has, by District definition, the facilities in place to carry out irrigation. However, these facilities were typically designed and installed for drainage, and are rarely used for irrigation. This is because the returns associated with cattle production no longer justify the expense associated with pasture irrigation. In fact the required pumps and other equipment necessary for irrigation are usually not operable. When irrigation is carried out, it is usually in a period of extreme drought and is done to prevent grass from dying.

The assumption was made that improved pasture will not be irrigated throughout the projection period. Although this assumption may not be the case in some rare instances, it is much closer to actual production practices than the values given by any irrigation requirement model.

Total pasture acreage (improved and unimproved) does affect the water required for cattle watering by limiting cattle population. Total pasture was projected by subtracting land expansion for other purposes from the current acreage of pasture. Note that pasture acreage includes wetlands which will not be converted to other agricultural uses. Unless otherwise stated, the 1990 pasture acreage estimate was obtained from the local IFAS extension office. Historical and primary projected changes in acreage for other uses were applied to that figure.

Water required for cattle watering was calculated as a function of the number of number and type of cattle (beef or dairy), which in turn was appraised as a function of the acreage used for pasture. Demand projections for cattle watering are based on the District allocation of 12 gal/day/cow for beef cattle and 185 gal/cow/day for dairy cattle (35 gal/cow/day for drinking and 150 gal/cow/day for barn washing).

Collier County

In 1990, Collier County had approximately 15,000 head of beef cattle and no dairy cattle (Florida Cattlemen's Association, 1990). These cattle account for 330,000 acres of improved and unimproved pasture. The association between cattle and acreage is 22 acres per head of cattle.

Lee County

In 1990, Lee County had 15,000 head of beef cattle and no dairy cattle (Florida Cattlemen's Association, 1990) accounting for 118,000 acres of improved and unimproved pasture. The association between cattle and acreage is approximately 7.9 acres per head of cattle.

Hendry County Area

In 1990, Hendry County had 117,000 head of beef cattle, and no dairy cattle (Florida Cattlemen's Association, 1990), accounting for 596,000 acres of improved and unimproved pasture. The association between cattle and acreage is 5.1 acres per head of cattle.

Glades County Area

In 1990, Glades County had 61,000 head of beef cattle and 4,000 head of dairy cattle (Florida Cattlemen's Association, 1990). The association between cattle and

acreage is about 5.1 acres per head of cattle. In 1989/1990 Glades County had approximately 4,000 head of dairy cattle. The dairy cattle population in Glades County is anticipated to remain relatively constant over the projection period.

Charlotte County Area

The 1986-1988 pasture acreage estimate (the most recent available) was obtained from District land use maps (SFWMD, 1987). There are no dairies in the Charlotte County Area, and the beef cattle approximation was based on the ratio estimated by the local IFAS extension office of 8 acres per head of beef cattle.

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TOTAL AVERAGE ANNUAL WATER DEMAND

Estimated and projected demands for the counties in the LWC Planning Area are shown in Table G-81. Demands are presented by use classification, with agricultural use broken down to its components. Neither the Charlotte, Glades, or Monroe county areas have significant urban demands. The Monroe County Area, in addition, lies entirely within Everglades National Park, and has no significant agricultural demands.

TABLE G-81. Annual Water Demand by Use Classification.

Use Classification	Average Annual Water Demand (MG)		
	1990	2000	2010
Collier County			
Public Water Supplied	13,385	19,706	26,028
Domestic Self Supplied	1,679	2,363	3,048
Comm. & Ind. Self Supplied	3,022	4,406	5,833
Landscape & Rec. Self Supplied	1,467	2,139	2,832
Golf Course	6,007	8,823	11,922
Agriculture	54,515	69,669	79,858
Citrus	24,116	39,916	49,745
Vegetables	27,650	27,650	27,650
Ornamental Nursery	2,683	2,041	2,405
Cattle Watering	66	62	58
TOTAL	80,075	107,106	129,521
Lee County			
Public Water Supplied	15,516	23,550	31,583
Domestic Self Supplied	2,821	3,207	3,592
Comm. & Ind. Self Supplied	11,425	16,863	21,827
Landscape & Rec. Self Supplied	8,578	12,666	16,389
Golf Course	6,265	8,140	10,432
Agriculture	22,766	25,733	28,845
Citrus	10,388	12,242	14,095
Tropical Fruit	1,765	2,088	2,410
Vegetables	8,396	9,375	10,106
Sod	1,113	1,113	1,113
Ornamental Nursery	1,038	853	1,059
Cattle Watering	66	62	62
TOTAL	67,371	90,159	112,688
Hendry County Area			
Public Water Supplied	1,427	1,836	2,245
Domestic Self Supplied	526	675	825
Golf Course	283	283	283

TABLE G-81. (Continued).

Use Classification	Average Annual Water Demand (MG)		
	1990	2000	2010
Hendry County Area (cont.)			
Agriculture	125,995	153,351	173,155
Citrus	53,972	74,339	94,137
Citrus Nursery	176	198	283
Sugarcane	61,814	68,712	68,712
Vegetables	3,322	3,153	2,838
Sod	4,947	4,947	4,947
Ornamental Nursery	1,562	1,810	2,057
Cattle Watering	202	192	181
TOTAL	128,231	156,145	176,508
Glades County Area			
Golf Course	24	24	24
Agriculture	26,033	36,343	46,515
Citrus	4,031	5,786	7,403
Sugarcane	19,753	28,209	36,665
Vegetables	60	60	60
Sod	1,149	1,149	1,149
Ornamental Nursery	859	958	1,058
Cattle Watering	181	181	180
TOTAL	26,057	36,367	46,539
Charlotte County Area			
Agriculture	5,327	5,797	6,271
Citrus	1,364	1,838	2,312
Vegetables	1,668	1,668	1,668
Field Crops	2,256	2,256	2,256
Cattle Watering	39	35	35
TOTAL	5,327	5,797	6,721
GRAND TOTAL	**307,061**	**395,574**	**471,507**

LWC Planning Area Total by Use (MGY)	Estimated 1990	Projected 2010	Percent of Total	
			1990	2010
Public Water Supplied	30,328	59,856	10%	13%
Domestic Self Supplied	5,026	7,465	2%	2%
Comm. & Ind. Self Supplied	14,447	27,660	5%	6%
Recreation Self Supplied	22,624	41,882	7%	9%
Agriculture	234,636	334,644	76%	71%

PROJECTED AGRICULTURAL LAND USE

Agricultural Land Use Projection Methodology

For modeling purposes the 1990 land use assessment reflects the permitted 1990 irrigated acreage and water withdrawals. In order to model forecast 2010 withdrawals and land use, the numerical acreage projections described previously in this appendix were allocated to suitable locations. Projections for land use changes in Collier, Lee, and Hendry counties were developed for citrus, sugarcane, and vegetables. Crops which were projected to remain at their 1990 level, or not to surpass their 1990 permitted level, were assigned to the 1990 permitted locations. The crop with the most change projected is citrus, with continued growth forecast through 2010, although at a significantly lower average growth rate than recently experienced. Some growth is also projected for sugarcane, vegetables, and ornamental nursery, while sod is anticipated to stay at about the 1990 level.

Citrus

The criteria considered in evaluating the suitability of areas in the LWC Planning Area for the expansion of citrus were land ownership and soil type. Available blocks of land which are 40 acres or larger were considered. A summary of the evaluations of these criteria are presented below. Justification of these methodologies and a description of the techniques used to determine ownership and soil suitability are described by Mazzotti *et al.*, 1992. Urban areas, land permitted for irrigated agricultural crops other than citrus, and protected wetlands were ruled out as potential sites for citrus expansion.

Land Ownership. Land ownership was rated with respect to ownership history of citrus production, with L1 as the highest rating and L3 the lowest.

L1. Land owned by an agricultural company or individual that is known to already own existing citrus groves within the IFAS study boundary area (Hendry, Collier, Glades, Lee, and Charlotte counties).

L2. Privately owned land in large tracts (>100 acres), owned by companies or individuals not known to own any existing citrus groves within the IFAS study boundary area.

L3. Land broken up into small tracts, residential areas, towns, subdivisions, or planned communities. Land owned by city, county, state, or federal government. Land owned by the Audubon Society.

Soil Feasibility. The feasibility for a given soil series to support a viable citrus grove was based on the Soil Conservation Service soil survey. Soils were identified with respect to ease of drainage, since this is the chief concern of the long-term survivability of citrus groves within the study area. Soils were grouped into three feasibility categories, with highest feasibility equal to S1 and lowest feasibility equal to S3.

S1- Flatwoods. In their natural state these soils occupy upland positions. Hammocks may be considered in a similar position for this rating system, although the soils within them may be quite different. Soils within the flatwoods grouping have a high potential to support citrus development because flooding is unlikely if a standard flatwoods grove drainage system is installed.

S2 - Sloughs. In their natural state these soils occupy transitional areas between flatwoods and depressions. These soils are more likely to flood under chronic high rainfall conditions than the soils classified as S1. Sloughs have the potential to support citrus development with a standard drainage system if it is sized properly and is well maintained.

S3 - Depressions. In their natural state these soils remain under ponded water for six months or more per year. In normal to deficient rainfall years, sandy soils within this grouping could support citrus development with a standard drainage system. However, intermittent flooding may occur during above normal rainfall years, which would be detrimental to the long-term health of citrus. It is doubtful that the muck soils within this grouping could support long-term viable citrus groves.

The two evaluations (land ownership and soil suitability) were evaluated in combination. For example, L1S1 refers to land classified as most appropriate for citrus both in terms of land ownership and soil suitability. Soils considered undevelopable wetlands were masked out (i.e., not considered as potential sites for citrus). The National Wetlands Inventory (NWI) classifies nontidal wetlands as follows:

H - Permanently flooded. Water covers the substrate throughout the year in all years. Ecotype: estuarine bay, harbor.

Z - Intermittently exposed. Surface water is present throughout the year except in years of extreme drought. Ecotype: seagrass bed.

F - Semipermanently flooded. Surface water persists throughout the rainy season (May through October) and much of the dry season (November through April) in most years. When surface water is absent, the water table is at or very near the land surface. Ecotype: maple swamp, willow head, Thalia marsh, deep marsh.

C - Seasonally flooded. Surface water is present throughout the rainy season, but is absent soon after the rainy season in most years. When surface water is absent, the water table is often near the land surface. Ecotype: Cypress dome, prairie pond, sawgrass marsh, mixed hardwood swamp.

B - Saturated. The substrate is saturated to the surface throughout the rainy season or for extended periods through the rainy season in most years. Surface water is seldom present. Ecotype: bayhead, seep, hydric hammock.

A - Temporarily flooded. Surface water is present for brief periods during the rainy season, but the water table usually lies well below the soil surface for most of the year. Plants that grow in both uplands and wetlands are characteristic of this water regime.

W - Intermittently flooded. The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal without detectable seasonal periodicity. Weeks, months, or years may intervene between periods of inundation. (Used rarely, if at all, in Florida. Ecotype: no known examples in the District.

K - Artificially flooded. The amount and duration of flooding is controlled by means of pumps or siphons in combination with dikes and dams. The vegetation growing in these areas cannot be considered a reliable indicator of water regime. Ecotype: conservation area, mitigation wetland.

From a regional perspective the Class A wetlands have the potential to be permitted for irrigated agriculture. However, the District's Regulation Department staff makes wetlands determinations based on vegetation on a case by case basis. In this analysis Class A wetlands were not excluded (masked) from potential citrus development sites.

The following steps were taken using Geographic Information System (GIS) software to geographically allocate the numerical citrus acreage projections described previously in this appendix:

1. Establish the locations permitted for citrus production for 1990.

2. Add the locations permitted for citrus production between 1990 and 1993.

3. Identify potential acreage growth within permit boundaries.
   a. Develop a GIS mask for wetland areas within citrus permit boundaries.
   b. Identify and allocate numerical acreage projections to areas outside the mask with the S1 soil type within citrus permit boundaries.
   c. Identify and allocate numerical acreage projections to areas outside the mask with the S2 soil type within citrus permit boundaries.

4. Identify potential acreage growth outside permit boundaries.
   a. Develop a GIS mask for areas outside citrus permit boundaries. This mask includes the 1993 permitted citrus locations, areas identified for irrigated crops other than citrus for the 2010 projection, wetlands, and urban areas.
   b. Identify and allocate the numerical acreage projections to areas outside the mask with the L1S1 ownership/soil type outside the 1993 citrus permit boundaries.
   c. Identify and allocate numerical acreage projections to areas outside the mask w ith the L1S2 ownership/soil type outside the 1993 citrus permit boundaries.

5. Create the output for the models by overlaying the grid with projected citrus growth areas.

Sugarcane

Sugarcane is produced commercially in the portions of Glades and Hendry counties within the LWC Planning Area. The local IFAS extension office identified areas of projected sugarcane expansion in the Hendry County Area. Some growth was also forecast within Hendry County's 1993 permit boundaries. These land use projections were consistent with the numerical acreage projections made earlier in this appendix.

Vegetables

In the model area, vegetable acreage is projected to stay at about its current level through 2010 in Collier County, and to grow moderately in Lee and Hendry counties. Vegetable acreage was assigned to the existing permitted irrigated locations, and if necessary, to additional areas with suitable soil within the current vegetable permit boundaries.

Other Crops

An increase in irrigated acreage for crops other than citrus, vegetables, or sugarcane was either insignificant or their total irrigation demands were small. Land use projections for Collier, Lee, and Hendry counties were made for citrus, sugarcane, vegetables, and sod. Citrus nursery acreage was included with citrus acreage. Ornamental nurseries are individually small, and make up a relatively insignificant portion of agricultural demands. No land use projection was made for ornamental nurseries: however, the existing permitted locations were included.

Results

Collier County. Agricultural land use projections were made for citrus and vegetables using the described methodologies. Citrus acreage was capped at 52,950 acres as shown in Table G-16. This represents the limit of growers with a history of citrus production in Collier County using suitable land for citrus production. Vegetable production was projected to remain at its current level.

Lee County. The increase in projected irrigated acreage in Lee County is modest in comparison to other counties in the LWC Planning Area. This acreage is accommodated within the current permitted boundaries.

Land use projections were made for citrus, tropical fruit, vegetables, and sod. The citrus land analysis by Mazzotti *et al.* 1992 did not include Lee County. However, an analysis titled "Lee County Soil Potential for Citrus" (Lee County Soil and Water Conservation District, 1992) contained soil suitability analyses. Soils were assigned a soil potential index (SPI). Those soils with highest SPI within existing permit boundaries were used to assign the relatively modest forecast growth in Lee County.

Hendry County. Agricultural land use projections were made for citrus, vegetables, sugarcane, and sod. The local IFAS extension office identified areas of projected sugarcane expansion. Some growth was also forecast within 1993 permit boundaries. These land use projections were consistent with the numerical acreage projections made earlier in this appendix.

Citrus locations were projected using the soil suitability and land ownership analysis previously described. There is enough suitable land within the current citrus permit boundaries in Hendry County to accommodate the numerical projections made earlier in the appendix.